Gurugram University Gurugram

Curriculum for UG Degree Course

in

Electrical and Electronics Engineering

(Engineering and Technology)

Gurugram University Gurugram

GENERAL COURSE STRUCTURE AND CREDIT DISTRIBUTION

STRUCTURE OF UNDERGRADUATE ENGINEERING PROGRAM

S.No.	Category	Breakup of Credits (Total 164.5)
1	Humanities and Social Sciences including Management courses	11
2	Basic Science courses	20
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc.	28.5
4	Professional core courses	69
5	Professional Elective courses relevant to chosen specialization/branch	12
6	Open subjects – Electives from other technical and /or emerging subjects	12
7	Project work, seminar and internship in industry or elsewhere	16
8	Mandatory Courses [Induction training, Sports, Constitution of India, Scientific and Technical Writing Skills, Economics for engineers	Non-credit
9	**Total**	**168.5**

SEMESTER WISE SUMMARY OF THE PROGRAM

S.No.	Semester	No. of Contact Hours	Marks	Credits
1.	I	25/24 + 2*	900	20.5/19.5
2.	II	28/29	1000	23/24
3.	III	32	1000	22
4.	IV	32	1000	22
5.	V	32	1100	23
6.	VI	33	1000	23
7.	VII	27	900	21
8.	VIII	22	500	14
	Total	**231**	**7400**	**168.5**

COURSE CODE AND DEFINITIONS

Course Code	Definitions
L	Lecture
T	Tutorial
P	Practical
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional core courses
PEC	Professional elective courses
OEC	Open Elective courses
LC	Laboratory course
MC	Mandatory courses
PROJ	Project

CREDIT DISTRIBUTION IN THE FIRST YEAR OF UNDERGRADUATE ENGINEERING PROGRAM

Bachelor of Technology Semester-1

Subject	Lecture (L)	Tutorial (T)	Laboratory/ Practical (P)	Total credits (C)
Communication Skills in English	2	0	0	2
Mathematics-I	3	1	0	4
Physics	3	1	0	4
Programing for problem solving using C	3	0	0	3
Basics of Environmental Science	2	0	0	2
Communication Skills in English(P).	0	0	2	1
Physics(P)	0	0	2	1
Programing for problem solving using C	0	0	2	1
Workshop Practices (P)	1	0	3	2.5
Sports (Audit Course) Compulsory	0	0	2	2*

ENGINEERING PROGRAM

Bachelor of Technology Semester-II

Subject	Lecture (L)	Tutorial (T)	Laboratory/ Practical (P)	Total credits (C)
Mathematics-II	3	1	0	4
Human Value and Soft Skills	2	0	2	3
Basic of Electrical Engineering	3	0	0	3
Data Structure Using C	3	0	0	3
Python Programming	3	0	0	3
Electronics Engineering-I	3	0	0	3
Basic of Electrical and Electronics Engineering(P)	0	0	2	1
Data Structure Using C(P)	0	0	2	1
Python Programming (P)	0	0	2	1
Electronics Engineering-I Lab(P)	0	0	2	1

HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT

S. No.	Code No.	Course Title	Hours Per week			Total Credits	Semester
			L	T	P		
1		Communication Skills in English	2	0	2	3	I
2		Basics of Environmental Science	2	0	0	2	I
3		Human Value and Soft Skills	2	0	2	3	II
4		Organizational Behaviour	3	0	0	3	VII
Total Credits						**11**	

BASIC SCIENCE COURSES (BSC)

S. No.	Code No.	Course	Hours Per Week			Total Credits	Semester
			L	T	P		
1		Physics	3	0	2	5	I
2		Mathematics-I	3	1	0	4	I
3		Mathematics-II	3	1	0	4	II
4		Mathematical and Computational Techniques	3	1	2	4	III
5		Probability Theory and Stochastic Processes	4	1	0	3	IV
Total Credits						**20**	

ENGINEERING SCIENCE COURSE (ESC)

S. No.	Code No.	Course Title	Hours Per Week			Total Credits	Semester
			L	T	P		
1		Programing for Problem Solving using C	3	0	2	4	I
2		Workshop Practices (P)	1	0	3	2.5	I
3		Data Structure Using C	3	0	2	4	II
4		Python Programming	3	0	2	4	II
5		Electronics Engineering-I	3	0	2	4	II
6		Basic of Electrical Engineering	3	0	2	4	II
7		MOOC-1 (Essential)	3	0	0	3	VIII
8		MOOC-2 (Essential)	3	0	0	3	VIII
					Total Credits	**28.5**	

PROFESSIONAL CORE COURSES (PCC)

S. No.	Code No.	Course Title	Hours Per Week			Total Credits	Semester
			L	T	P		
1.		Electrical Machine I	3	1	2	4	III
2.		Digital Electronics	3	1	2	4	III
3.		Network Analysis and Synthesis	3	1	2	4	III
4.		Signals and System	3	0	0	3	III
5.		Electromagnetic Field Theory	3	0	0	3	III
6.		Transmission and Distribution	3	1	2	4	IV
7.		Electrical Machine II	3	1	2	4	IV
8.		Power Electronics	3	1	2	4	IV
9.		Electronic Measurement and Instrumentation	3	0	2	4	IV
10.		Electric Engineering Materials	3	0	0	3	IV
11.		Power System I	3	1	2	4	V
12.		Digital System Design	3	1	2	4	V
13.		Communication Systems	3	1	2	4	V
14.		Digital Signal Processing	3	1	2	4	V
15.		Power System II	3	1	2	4	VI
16.		Control System	3	1	2	4	VI
17.		Microprocessors and Microcontrollers	3	1	2	4	VI
18.		Renewable Energy and Distributed Generation	3	0	2	4	VII
					Total Credits	**69**	

PROFESSIONAL ELECTIVE COURSES (PEC)

S. No.	Code No.	Course Title	Hours Per Week			Total Credits	Semester
			L	T	P		
1		Professional Elective I	3	0	0	3	V
2		Professional Elective II	3	0	0	3	VI
3		Professional Elective III	3	0	0	3	VI
4		Professional Elective IV	3	0	0	3	VII
Total Credits						**12**	

OPEN ELECTIVE COURSES (OEC)

S. No.	Code No.	Course Title	Hours Per Week			Total Credits	Semester
			L	T	P		
1		Open Elective I	3	0	0	3	V
2		Open Elective II	3	0	0	3	VI
3		Open Elective III	3	0	0	3	VII
4		Open Elective IV	3	0	0	3	VII
Total Credits						**12**	

PROJECT WORK, SEMINAR AND INTERNSHIP IN INDUSTRY OR ELSEWHERE

S. No.	Code No.	Course Title	Hours Per Week			Total Credits	Semester
			L	T	P		
1		Practical Training-I	0	0	2	1	V
2		Project-I	0	0	4	2	VI
3		Practical Training-II	0	0	2	1	VII
4		Project-II	0	0	8	4	VII
5		Industrial Project/Project-III	0	0	16	8	VIII
Total Credits						**16**	

Semester wise Structure and Curriculum for

UG Course in

Electrical and Electronics Engineering

(Engineering and Technology)

Gurugram University
Scheme of Studies and Examination
Bachelor of Technology (SCHEME A2) Semester-1

Sr. No.	Course Code	Course Title	Hours per week			Total Contact Hrs. per week	Credit
			L	T	P		
1.	HSE-101	Communication Skills in English	2	0	0	2	2
2.	BSM-103	Mathematics-I	3	1	0	4	4
3.	BSP-103 OR EEE-103	Physics OR Basics of Electrical Engineering	3 3	1 0	0 0	4 OR 3	4 OR 3
4.	CSE-101	Programming for problem solving using C	3	0	0	3	3
5.	ENV-101	Basics of Environmental Science	2	0	0	2	2
6.	HSE-101P	Communication Skills in English (P)	0	0	2	2	1
7.	BSP-103P OR EEE-103P	Physics (P) OR Basics of Electrical Engineering (P)	0	0	2	2	1
8.	CSE-101P	Programming for problem solving using C (P)	0	0	2	2	1
9.	MEE-102P	Workshop Practices (P)	1	0	3	4	2.5
10.	AUS-101	Sports (Audit Course) Compulsory	0	0	2	2*	0
Total						**25/ 24+2***	**20.5/19.5**

Gurugram University Scheme of Studies and Examination

Bachelor of Technology (SCHEME A2) Semester-2

Sr. No.	Course Code	Course Title	Hours per week			Total Contact Hrs. per week	Credit
			L	T	P		
1.	BSM-104	Mathematics-II	3	1	0	4	4
2.	HSV-102	Human Value & Soft Skills	2	0	2	4	3
3.	EEE-103 OR BSP-103	Basics of Electrical Engineering OR Physics	3 3	0 1	0 0	3 OR 4	3 OR 4
4.	CSE-102	Data Structure Using C	3	0	0	3	3
5.	CSE-106	Python Programming	3	0	0	3	3
6.	ECE-102	Electronics Engineering-I	3	0	0	3	3
7.	EEE-103P OR BSP-103P	Basics of Electrical Engineering (P) OR Physics (P)	0	0	2	2	1
8.	CSE-102P	Data Structure Using C (P)	0	0	2	2	1
9.	CSE-106P	Python Programming (P)	0	0	2	2	1
10.	ECE-102P	Electronics Engineering-I (P)	0	0	2	2	1
Total						**28 / 29**	**23/24**

Gurugram University Scheme of Studies and Examination

Bachelor of Technology Semester 3

S.No.	Category	Course Code	Course Title	Hours per week			Credits	Marks for Sessional	Marks for End Term Examination	Total
				L	T	P				
1	PCC		Electrical Machine I	3	1	0	3	30	70	100
2	BSC		Mathematical and Computational Techniques	3	1	0	3	30	70	100
3	PCC		Digital Electronics	3	1	0	3	30	70	100
4	PCC		Network Analysis and Synthesis	3	1	0	3	30	70	100
5	PCC		Signals and System	3	0	0	3	30	70	100
6	PCC		Electromagnetic Field Theory	3	0	0	3	30	70	100
7	LC		Electrical Machine I Lab	0	0	2	1	50	50	100
8	LC		Mathematical and Computational Techniques Lab	0	0	2	1	50	50	100
9	LC		Digital Electronics Lab	0	0	2	1	50	50	100
10	LC		Network Analysis and Synthesis Lab	0	0	2	1	50	50	100
11	Non credit		Constitution of India *	2	0	0	-	30	70	100*
Total							**22**			**1000**

***Note:** The examination of the regular students will be conducted by the concerned college/Institute internally. Each student will be required to score a minimum of 40% marks to qualify in the paper. The marks will not be included in determining the percentage of marks obtained for the award of a degree.

Gurugram University Scheme of Studies and Examination

Bachelor of Technology Semester 4

S.No.	Category	Course Code	Course Title	Hours per week			Credits	Marks for Sessional	Marks for End Term Examination	Total
				L	T	P				
1	PCC		Transmission and Distribution	3	1	0	3	30	70	100
2	PCC		Electrical Machine II	3	1	0	3	30	70	100
3	PCC		Power Electronics	3	1	0	3	30	70	100
4	PCC		Electronic Measurement and Instrumentation	3	0	0	3	30	70	100
5	PCC		Electric Engineering Materials	3	0	0	3	30	70	100
6	BSC		Probability Theory and Stochastic Processes	3	1	0	3	30	70	100
7	LC		Transmission and Distribution Lab	0	0	2	1	50	50	100
8	LC		Electrical Machine II Lab	0	0	2	1	50	50	100
9	LC		Power Electronics Lab	0	0	2	1	50	50	100
10	LC		Electronic Measurement and Instrumentation Lab	0	0	2	1	50	50	100
11	Non credit		Scientific and Technical Writing Skills*	2	0	0	0	30	70	100*
Total							**22**			**1000**

***Note:** The examination of the regular students will be conducted by the concerned college/Institute internally. Each student will be required to score a minimum of 40% marks to qualify in the paper. The marks will not be included in determining the percentage of marks obtained for the award of a degree.

At the end of 4th semester each student has to undergo Practical Training of 4/6 weeks in an Industry/Institute/ Professional Organization/Research Laboratory/ training centre etc. and submit typed report along with a certificate from the organization and its evaluation shall be carried out in the 5th Semester.

Gurugram University Scheme of Studies and Examination

Bachelor of Technology Semester 5

S.No.	Category	Course Code	Course Title	Hours per week			Credits	Marks for Sessional	Marks for End Term Examination	Total
				L	T	P				
1	PCC		Power System I	3	1	0	3	30	70	100
2	PCC		Digital System Design	3	1	0	3	30	70	100
3	PCC		Communication Systems	3	1	0	3	30	70	100
4	PCC		Digital Signal Processing	3	1	0	3	30	70	100
5	PEC		Professional Elective I	3	0	0	3	30	70	100
6	OEC		Open Elective I	3	0	0	3	30	70	100
7	LC		Power System I Lab	0	0	2	1	50	50	100
8	LC		Digital System Design Lab	0	0	2	1	50	50	100
9	LC		Communication Systems Lab	0	0	2	1	50	50	100
10	LC		Digital Signal Processing Lab	0	0	2	1	50	50	100
11	PT		Practical Training-I	0	0	2	1	100	-	100
Total							**23**			**1100**

NOTE:

1. Choose any one from Professional Elective Course-I
2. Choose any one from Open Elective Course-I
3. **Practical Training-I:** The examination of the regular students will be conducted by the concerned college/Institute internally. Each student will be required to score a minimum of 40% marks to qualify in the paper. The marks will not be included in determining the percentage of marks obtained for the award of a degree.

PROFESSIONAL ELECTIVE- I (Semester-V)

Sr. No	Code	Subject	Credit
1.		Special Electrical Machine	3
2.		VLSI	3
3.		Nano Electronics	3
4.		High Speed Electronics	3
5.		Bio-Medical Electronics	3
6.		Power Quality	3

Gurugram University Scheme of Studies and Examination

Bachelor of Technology Semester 6

S.No.	Category	Course Code	Course Title	Hours per week			Credits	Marks for Sessional	Marks for End Term Examination	Total
				L	T	P				
1	PCC		Power System II	3	1	0	3	30	70	100
2	PCC		Control System	3	1	0	3	30	70	100
3	PCC		Microprocessors and Microcontrollers	3	1	0	3	30	70	100
4	PEC		Professional Electives II	3	0	0	3	30	70	100
5	PEC		Professional Electives III	3	0	0	3	30	70	100
6	OEC		Open Elective II	3	0	0	3	30	70	100
7	LC		Power System II Lab	0	0	2	1	50	50	100
8	LC		Control System Lab	0	0	2	1	50	50	100
9	LC		Microprocessors and Microcontrollers Lab	0	0	2	1	50	50	100
10	PROJ		Project-I	0	0	4	2	50	50	100
11	HSMC		Economics for Engineers*	2	0	0	-	30	70	100*
Total							**23**			**1000**

NOTE:

1. At the end of the 6th semester, each student has to undergo Practical Training of 4/6 weeks in an Industry/ Institute/ Professional Organization/ Research Laboratory/ training center etc. and submit the typed report along with a certificate from the organization and its evaluation shall be carried out in the 7th Semester.
2. Choose any one from each of the Professional Elective Course-II and III
3. Choose any one from Open Elective Course-II

PROFESSIONAL ELECTIVE- II (Semester-VI)

Sr. No	Code	Subject	Credit
1.		Robotics and Automation	3
2.		Energy Management and Auditing	3
3.		Introduction to MEMS	3
4.		Wireless Sensor Networks	3
5.		Mobile Communications	3

PROFESSIONAL ELECTIVE- III (Semester-VI)

Sr. No	Code	Subject	Credit
1.		Power Plant Engineering	3
2.		Power System Protection	3
3.		Electrical and Hybrid Vehicle	3
4.		Modelling and Analysis of Electrical Machines	3
5.		Electrical Safety and Standards	3

***Note:** The examination of the regular students will be conducted by the concerned college/Institute internally. Each student will be required to score a minimum of 40% marks to qualify in the paper. The marks will not be included in determining the percentage of marks obtained for the award of a degree.

Gurugram University Scheme of Studies and Examination

Bachelor of Technology Semester 7

S.No.	Category	Course Code	Course Title	Hours per week			Credits	Marks for Sessional	Marks for End Term Examination	Total
				L	T	P				
1	PCC		Renewable Energy and Distributed Generation	3	0	0	3	30	70	100
2	HSMC		Organizational Behavior	3	0	0	3	30	70	100
3	PEC		Professional Elective-IV	3	0	0	3	30	70	100
4	OEC		Open Elective-III	3	0	0	3	30	70	100
5	OEC		Open Elective-IV	3	0	0	3	30	70	100
6	PT		Practical Training-II	0	0	2	1	100	-	100
7	PROJ		Project-II	0	0	8	4	100	100	200
8	LC		Renewable Energy and Distributed Generation Lab	0	0	2	1	50	50	100
Total							**21**			**900**

NOTE:

1. Choose any one from Professional Elective Course-IV
2. Choose any one from each of the Open Elective Course-III and IV

PROFESSIONAL ELECTIVE- IV (Semester-VII)

Sr. No	Code	Subject	Credit
1.		High Voltage Engineering	3
2.		Intelligent Instrumentation	3
3.		Solar Technology Appliances and Application	3
4.		Advanced Power Electronics	3
5.		Renewable Energy Converters	3

Gurugram University Scheme of Studies and Examination

Bachelor of Technology Semester 8

S.No.	Category	Course Code	Course Title	Hours per week			Credits	Marks for Sessional	Marks for End Term Examination	Total
				L	T	P				
1	ESC		MOOC-1 (Essential)	3	0	0	3	25	75	100
2	ESC		MOOC-2 (Essential)	3	0	0	3	25	75	100
3	PROJ		Industrial Project / Project-III	0	0	16	8	150	150	300
Total							**14**			**500**

Gurugram University
Scheme of Studies and Examination
Bachelor of Technology (SCHEME A2) Semester-1

Sr. No.	Course Code	Course Title	Hours per week			Total Contact Hrs. per week	Credit
			L	T	P		
1.	HSE-101	Communication Skills in English	2	0	0	2	2
2.	BSM-103	Mathematics-I	3	1	0	4	4
3.	BSP-103 OR EEE-103	Physics OR Basics of Electrical Engineering	3 3	1 0	0 0	4 OR 3	4 OR 3
4.	CSE-101	Programming for problem solving using C	3	0	0	3	3
5.	ENV-101	Basics of Environmental Science	2	0	0	2	2
6.	HSE-101P	Communication Skills in English (P)	0	0	2	2	1
7.	BSP-103P OR EEE-103P	Physics (P) OR Basics of Electrical Engineering (P)	0	0	2	2	1
8.	CSE-101P	Programming for problem solving using C (P)	0	0	2	2	1
9.	MEE-102P	Workshop Practices (P)	1	0	3	4	2.5
10.	AUS-101	Sports (Audit Course) Compulsory	0	0	2	2*	0
Total						**25/ 24+2***	**20.5/19.5**

Course code	HSE-101				
Category	Humanities and Social Sciences				
Course title	Communication Skills in English				
Scheme and Credits	L	T	P	Credits	
	2	0	0	2	
Class work/ Practical	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Objectives of the course:

- **a.** The course will focus on the four integral skills of language, improving the proficiency levels in all of them and to learn to use language as a tool for effective communication.
- **b.** This course will widen the understanding of the learners in all genres of literature (short stories, poetry, autobiographies.) with the help of expository pieces .
- **c.** The course will strive to equip the learner with the ability to express oneself and be understood by others with clarity and precision, in both written and spoken forms.
- **d.** This course will encourage creative use of language through translation, paraphrasing and paragraph writing.
- **e.** Along with the above, the course will also build confidence and encourage the students to use a standard spoken form of English in order to prepare them to face job interviews, workplace and in higher studies.

Unit:1

Remedial English : Parts of speech, Gerunds, Participles and infinitives; Clauses; Sentence constructions (unity; avoidance of choppy and rambling sentences, logic and consistency, conciseness, sequencing of ideas); Sentence errors-agreement between verb and subject, pronoun and antecedents, sequence of tenses, problems involving modifiers (dangling and misplaced modifiers); Shifts in point of view consistency of number and person, tense, mood, voice and subject; Parallelism; Omissions and mixed constructions.

Unit: 2

Vocabulary : Methods of building vocabulary-etmological roots, prefixes and suffixes; Commonly used foreign words and phrases; spelling; words often confused synonyms and homonyms; one word substitutes; verbal idioms.

Unit: 3

Punctuation and Mechanics: End Punctuation; internal Punctuation; Word Punctuation. Comprehension: Abstracting; Summarizing; Observation, Findings and Conclusions; Illustration and Inductive Logic; Deduction and Analogy.

Unit: 4

Presentation: Oral presentation- Extempore, discussion on topics of contemporary relevance, Interviews.

Written Comprehension: The ability to write after listening to and reading select speeches, news bulletins, presentations and answering questions based on what has been heard. Reading the given texts to skim, scan, infer and answer comprehension questions. Reading texts like case studies and project reports for critical assessment and book Review.

Suggested Books:

1. Nitin Bhatnagar and Mamta Bhatnagar, Communicative English for Engineers and Professionals. Pearson Education.
2.Bhatnagar, k. Manmohan.Ed. The Spectrum of Life: An Anthology of Modern Prose. Delhi: Macmillan India Ltd., 2006.
3 C. Murlikrishna& Sunita Mishra, Communication Skills for Engineers, Pearson Ed.
4 Sinha, R.P.Current English Grammar and Usage. OUP.
5.Rizvi, M. Ashraf.Effective Technical Communication. McGraw Hill Education (India) Pvt. Ltd., 2014.
6.Eastwood, John.Oxford Guide to English Grammar.OUP, 2010.
7.Kumar, Sanjay and PushpLata. Communication Skills. OUP, 2011.
8. Raman, Meenakshi and Sangeeta Sharma.CommunicationSkills.NewDelhi:OUP,2011.
9.Hill, L.A.A Guide to Correct English.London:OUP,1965.
10.Oxford Dictionary of English Idioms. New Delhi: OUP, 2009
11*http://yousigma.com/religionandphilosophy/swamivivekananda/thescecretofwork.pdf

Course code	BSM-103				
Category	Basic Science Course				
Course title	Mathematics-I				
Scheme and Credits	L	T	P	Credits	
	3	1	0	4	
Class work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Objectives of the course

1. To develop logical understanding of the subject
2. To develop mathematical skill so that students are able to apply mathematical methods & principals in solving problem from Engineering fields.
3. To make aware students about the importance and symbiosis between Mathematics and Engineering.

Unit-I

Matrices & Its Application:

Elementary Matrices, Elementary Transformations, Inverse using elementary transformations, Rank of a matrix, Normal form of a matrix, Linear dependence and independence of vectors, Consistency of linear system of equations, Linear and Orthogonal Transformations, Eigenvalues and Eigenvectors, Properties of eigenvalues, Cayley-Hamilton Theorem, Diagonalization of Matrices.

Unit-II

Sequences and Series:

Convergence of sequence and series, Tests for convergence, Power series: Taylor's series, series for exponential, trigonometric and logarithm functions, Fourier series: Half range sine and cosine series, Parseval's theorem.

Unit-III

Differential Calculus: Limit, Continuity and Differentiability of function of single variable, Successive Differentiation, Leibnitz Theorem, Taylor's and Maclaurin's Series for Single

Variable function, Partial derivatives, Homogeneous functions, Euler's Theorem, Jacobian, Maxima-Minima of function of two variables, Lagrange's Method of undetermined multipliers.

Unit-IV

Integral Calculus: Basic concepts of integration and properties of definite integrals, Applications of single integration to find volume of solids and surface area of solids of revolution, Double integral, Change of order of integration, Double integral in Polar Co-ordinates, Applications of double integral to find area enclosed by plane curves, Triple integral, Beta and Gamma functions.

Reference Books:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, Pearson Education.

2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.

3. D. Poole, Linear Algebra: A Modern Introduction, Brooks Cole.

4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw-Hill Publishing Company Limited.

5. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications.

6. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.

7. V. Krishnamurthy, V.P. Mainra and J. L. Arora, An introduction to Linear Algebra, Affiliated East– West Press Private limited

Course code	BSP-103				
Category	**Basic Science Course**				
Course title	**Physics**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	
	3	**1**	**0**	**4**	
Class work	**30 Marks**				
Exam	**70 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Objectives of the course

1. To impart knowledge of basic concepts in applied physics
2. To enhance the analytical capability of the engineering students.
3. To givea balance account of the fundamentals of Physics as well as some of recent developments in this area best suited to the Engineering applications in different branches and to provide the knowledge and methodology necessary for solving problems in the field of engineering.

UNIT – I

Electrostatics in vacuum and linear dielectric medium

Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential Boundary conditions of electric field and electrostatic potential; energy of a charge distribution and its expression in terms of electric field. Electrostatic field and potential of a dipole. Bound charges due to electric polarization; Electric displacement; boundary conditions on displacement.

UNIT – II

Electromagnetism and Magnetic Properties of Materials

Laws of electrostatics, electric current and the continuity equation, laws of magnetism. Ampere's Faraday's laws. Maxwell's equations. Polarisation, permeability and dielectric constant, polar and non-polar dielectrics, applications of dielectric Magnetisation, permeability and susceptibility, classification of magnetic materials, ferromagnetism, magnetic domains and hysteresis, applications.

UNIT – III

Wave Optics and Lasers

Wave Optics: Huygens' principle, superposition of waves and interference of light by wave-front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson

interferometer. Fraunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power.
Lasers: Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO), solid-state lasers (ruby, Neodymium), dye lasers; Properties of laser beams: mono-chromaticity.

UNIT – IV
Introduction to Solids and Semiconductors
Free electron theory of metals, Fermi level, density of statesin1, 2 and 3 dimensions, Bloch's theorem for particles in a periodic potential, Kronig-Penney model and origin of energy bands. Types of electronic materials: metals, semiconductors, and insulators. Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p -n junction.

Suggested Reference books

1. E. Hecht, "Optics", Pearson Education
2. D. J. Griffiths, "Quantum mechanics", Pearson Education
3. B.G. Streetman, "Solid State Electronic Devices", Pearson Education
4. G. Main, "Vibrations and waves in physics", Cambridge University Press
5. H. J. Pain, "The physics of vibrations and waves", Wiley
6. A. Ghatak, "Optics", McGraw Hill Education,
7. O. Svelto, "Principles of Lasers", Springer Science & Business Media,
8. R. Robinett, "Quantum Mechanics", OUP Oxford
9. D. McQuarrie, "Quantum Chemistry", University Science Books
10. D. A. Neamen, "Semiconductor Physics and Devices", Times Mirror High Education Group, Chicago
11. E.S. Yang, "Microelectronic Devices", McGraw Hill, Singapore

Course code	EEE-103				
Category	**Engineering Science Course**				
Course title	**Basics of Electrical Engineering**				
Scheme and Credits	L	T	P	Credits	
	3	**0**	**0**	3	
Class work	**30 Marks**				
Exam	**70 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Objectives of the course

To explain the laws used in the analysis of DC and AC circuits.
To explain the behavior of circuit elements in single-phase circuits.
To explain the construction and operation of transformers, DC generators and motors, Induction motors, and synchronous generators.

Unit: 1.
DC Circuits:
Concept of electrical fields, charge, current, voltage, energy and their inter relationships. Electrical networks elements (R, L and C), voltage and current sources (ideal & controlled), series and parallel circuits.

Classification of electrical networks, Ohm's law, Kirchhoff's law and their applications for network solutions (Nodal and Mesh Analysis), Source transformation, star delta conversion. Network theorems: Superposition theorem, Thevenin and Norton Theorems, Millman Theorem, maximum power transfer theorem, Substitution and Reciprocity theorems.

Unit: 2

Electrostatics: Electrostatics field, electric flux density, electric field strength, absolute permittivity, relative permittivity, capacitance and capacitor, composite dielectric capacitors, capacitors in series and parallel, energy stored in capacitors, charging and discharging of capacitors and time constant.

AC Fundamentals: Sinusoidal voltages and currents, their mathematical and graphical representation, concept of instantaneous, peak (maximum), average and R.M.S. values, frequency,
cycle, period, peak factor and form factor, phase difference, lagging, leading and in phase quantities and phasor representation. Rectangular and polar representation of phasors.

Unit: 3
AC Circuits: Study of Single phase series and parallel R-L, R-C, R-L-C circuits, concept of impedance and admittance for different combinations, wave form and relevant voltage current phasor diagrams.

Concept of active power, reactive power, apparent power, complex power, power factor and resonance in series and parallel RLC circuit. Q- factor and bandwith. Introduction to three- phase circuits.

Single phase transformers: Construction, principle of working, E.M.F. equation, voltage and current ratios. Losses, definition of regulation and efficiency, determination of these by direct loading method. autotransformers and dimmer stats

Unit: 4

Electrical Machines: Introduction, Generation of rotating magnetic fields. Construction and working of separately excited DC motor, Single-phase induction motor, Three-phase induction motor and Synchronous generators.

Safety measures: Electric Shock, Earthing and its types, Safety Precautions to avoid shock, and Working principle of Fuse and Miniature circuit breaker (MCB), Residual Current Circuit Breaker (RCCB).

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Suggested books:

1. E. Huges, "Electrical Technology", ELBS.

Suggested reference books

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. V. Del Toro, "Principles of Electrical engineering", PHI.
3. Basic Electrical Engineering, A.E. Fitzgerald , David Higginbotham 2009 , Arvin Grabel, Tata McGraw-Hill Publishing Company; 5th Edition.

Course code	CSE-101				
Category	Professional Core Course				
Course title	Programming for Problem Solving Using C				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Unit 1

Introduction to Programming: Idea of Algorithm: Steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. C Programming: Keywords, Variables and Data Types: basic, derived and user defined, Type Conversions, Header Files, Basic Input and Output Functions and Statements, Compilation, Syntax and Logical Errors in compilation, Object and Executable Code, Storage Classes, Arithmetic Expressions and Precedence.

Unit 2

Preprocessors, Conditional and Branching Statements, Loops/ Iterative Statements, Writing and evaluation of conditionals and consequent branching.

Unit 3

Arrays (1-D, 2-D), Character Arrays and Strings, Arrays with Pointers, Functions (including using built in libraries), Parameter passing in functions, Call by Value, Call by Reference, Passing arrays to functions, Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc.

Unit 4

Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, Introduction to Dynamic Memory Allocation and its Methods, Structures, Union, Defining Structures and Array of Structures, File Handling.

Suggested Text Books:

Ajay Mittal, Programming in C, 'A Practical Approach', Pearson Education.
Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
Yashavant Kanetkar, Let Us C, BPB Publication.

Suggested Reference Books

Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India.

Course code	ENV-101				
Category	Humanities and Social Sciences				
Course title	Basics of Environmental Science				
Scheme and Credits	L	T	P	Credits	
	2	0	0	2	
Class work/Practical	50Marks				
Exam	50Marks				
Total	100Marks				
Duration of Exam	03 Hours				

Course Objective:
To impart the knowledge and awareness for the environmental protection for real-time contribution during an execution of engineering practices in the society.

Unit 1
Environmental studies and Natural Resources:
Definition, scope and importance of environmental studies.
Natural Resources: Renewable and non-renewable resources, and associated problems
(a) Forest resources: Use and over-exploitation, deforestation, Timber extraction, mining, dams and their effects on forests and tribal people.
(b)Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dam's benefits and problems.
(c) Mineral Resources: Use and exploitation, environmental effects of extracting and using mineral resources.
(d)Food Resources: World food problems, changes caused by agriculture and over grazing, effects of modern agriculture, fertilizers-pesticides problems, water logging, salinity.
(e) Energy Resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources.

Unit 2
Eco Systems:
Concept of an eco-system, Structure and function of an eco-system, Producers, consumers, decomposers, Energy flow in the ecosystems, Ecological succession, Food chains, food webs and ecological pyramids.
Introduction, types, characteristic features, structure and function of the following ecosystems:
(a) Forest ecosystem
(b) Grass land ecosystem
(c) Desert ecosystem
(d) Aquatic eco systems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit 3

Environmental Pollution:

Definition, Causes, effects and control measures of;

(a) Air pollution

(b)Soil pollution

(c) Marine pollution

(d)Noise pollution

(e) Nuclear hazards

Disaster management: Floods, earth quake, cyclone and landslides.

Unit 4

Social issues and the Environment:

From unsustainable to sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management.

Environmental ethics: issues and possible solutions, Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Environment protection Act, Air (prevention and control of pollution) Act, Water (prevention and control of pollution) Act, Wildlife protection Act, Forest conservation Act, Issues involved in enforcement of environmental legislations.

Recommended Books:

1. Textbook of Environmental studies, Erach Bharucha, UGC.

2. Fundamental concepts in Environmental Studies, D. D. Mishra, S Chand & Co Ltd.

Course Outcomes :

1.To understand the basic concepts of environmental studies and natural resources.

2. To learn about the various eco-systems of nature.

3. To gain knowledge about different types of environmental pollutions and their control measures.

4. To acquire the knowledge about the various social aspects related to the environment.

Communication Skills in English (P)

Course code	HSE-101P				
Category	Humanities and Social Sciences				
Course title	Communication Skills in English (P)				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Class work/ Practical	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Lab Activity: The students will acquire basic proficiency in English with special emphasis on listening, comprehension and speaking skills both at social and professional platforms.

(i) Listening comprehension
(ii) Recognition of phonemes in International Phonetic Alphabet
(iii) Self introduction and introduction of another person
(iv) Conversation and dialogues in common everyday situations
(v) Communication at work place (Standard phrases and sentences in various situations)
(vi) Telephonic communication
(vii) Speeches for special occasions (Welcome speeches, Introduction speeches, Felicitation speeches and Farewell speeches)
(viii) Tag Questions
(ix) Formal Presentations on literary texts prescribed in theory paper, Question Formation & Mock Press Conference

PHYSICS Lab

Course code	BSP-103P				
Category	**Basic Science Course**				
Course title	**Physics (P)**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	
	0	**0**	**2**	**1**	
Class work	**50 Marks**				
Exam	**50 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note: At least 8 experiments are to be performed by the students.

List of Subject related Experiments:

1. To find out wavelength of monochromatic light using Newton's ring experiment.
2. To find out wavelength of monochromatic light using Diffraction grating.
3. To find out wavelength of monochromatic light using Freshnel's bi-prism
4. To study interference phenomena using Michelson's Interferometer and to find out wavelength of monochromatic light.
5. To study Hall effect in semiconductors and measure the Hall coefficient.
6. To find frequency of AC mains using sonometer.
7. To study the magnetic properties of materials using B-H curve.
8. To study the Curies temperature of materials using Dielectric set up.
9. To verify the inverse square law with the help of a photovoltaic cell.
10. To determine Planks constant using photocell.
11. To study the characteristics of Solar cell and find out the fill factor.
12. To find temperature co-efficient of platinum using Callender Griffith bridge.
13. To study the forward and reverse characteristics of P-N junction diode.

Course code	EEE-103P				
Category	Engineering Science Course				
Course title	**Basics of Electrical Engineering (P)**				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Class work	50 Marks				
Exam	**50 Marks**				
Total	**100 Marks**				
Duration of Exam	03 Hours				

Note: At least 8 experiments are to be performed by the students.

List of Subject related Experiments:

1. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. (Resistors, Capacitors and Inductors)

2. Verification of Ohm's Law, Kirchhoff current and voltage laws

3. To measure the power in three phase circuits using two wattmeter method.

4. To verify Thevenin's and Norton theorems.

5. To verify Maximum power transfer and Superposition theorems.

6. To perform direct load test of a transformer and plot efficiency Vs load characteristic.

7. To perform O.C. and S.C. tests of a transformer.

8. Measurement of power in a 3-phase system by two wattmeter method.

9. Measurement of power by 3 voltmeter/3 Ammeter method.

10. To verify the resonance in R-L-C circuits.

11. 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.

12. Torque Speed Characteristic of shunt dc motor.

Course code	CSE-101P				
Category	Professional Core Course				
Course title	Programming for Problem Solving Using C (P)				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Class work	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: At least 6 experiments are to be performed by the students.

List of Subject related Experiments:

Laboratory Outcomes

- To formulate the algorithms for simple problems
- To translate given algorithms to a working and correct program
- To be able to correct syntax errors as reported by the compilers
- To be able to identify and correct logical errors encountered at run time
- To be able to write iterative as well as recursive programs
- To be able to represent data in arrays, strings and structures and manipulate them through a program

Tutorial 1: Problem solving using computers:
Lab1: Familiarization with programming environment

Tutorial 2: Variable types and type conversions:
Lab 2: Simple computational problems using arithmetic expressions

Tutorial 3: Branching and logical expressions:
Lab 3: Problems involving if-then-else structures

Tutorial 4: Loops, while and for loops:
Lab 4: Iterative problems e.g., sum of series
Tutorial 5: 1D Arrays
Lab 5: 1D Array manipulation

Tutorial 6: 2D arrays and Strings
Lab 6: Matrix problems, String operations

Tutorial 7: Functions, call by value:
Lab 7: Simple functions

Course code	MEE-102P				
Category	Engineering Science Course				
Course title	Workshop Practices (P)				
Scheme and Credits	L	T	P	Credits	
	1	0	3	2.5	
Class work	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Objectives of the course

1. To impart fundamental Knowledge of engineering practices such as fitting, wood working, foundry, machining, welding, etc. for manufacturing a product.
2. To prepare the students to understand the various tools and equipment's used in these processes and their working principle
3. To impart fundamental Knowledge of Lathe machine
4. To able to understand the basic knowledge of various welding processes

Class Work

Introduction:

Introduction to Manufacturing Processes and their Classification, Introduction to additive manufacturing, Industrial Safety.

Machining Shop

Lathe, description of lathe: headstock, tailstock, gearbox, carriage, apron, cutting speed, feed & depth of cut, cutting tools, Chucks: 3 jaw, 4 jaw.

Fitting shop:

Introduction, classification of metals: ferrous and nonferrous, fitting tools: measuring and marking tools, marking schemes for a fitting jobs, cutting tools.

Carpentry shop:

Introduction of carpentry, types of woods, carpentry tolls: measuring tools, marking tolls, cutting tools: saws, chisels, planning tools, drilling tools, striking tools, drilling tools, wood working joints, wood working lathe.

Foundry Shop

Introduction, foundry hand tools, measuring boxes, ladle, moulding, furnaces,Pattern: Types of Pattern and Allowances

Welding Shop

Introduction to welding, Classification of Welding Processes,Arc welding & Gas welding equipment's.

Reference Books:

1. S K Hajra Choudhury, Nirjhar Roy, A K Hajra Choudhury, Elements of workshop Technology (vol. 1&2), Media Promoters.
2. B S Raghuwanshi, A Course in Workshop Technology (manufacturing Process vol. 1& 2) Dhanpat Rai & CO.
3. O.P. Khanna, Workshop Technology. Dhanpat Rai Publication.
4. W A J Chapman, Workshop technology in SI unit (part – 1 &2), Mc Graw Hill Education.
5. M.P. GROOVER, Principles of Modern Manufacturing, Wiley.
6. Kalpakjian, Manufacturing Process for Engineering Materials, Pearson Education India.

Lab Work

List of Experiments

1. To study different types of measuring tools used in metrology and determine least counts of vernier callipers, micrometres and vernier height gauges.

2. To study different types of machine tools (lathe, shaper, planer, milling, drilling machines)

3. To prepare a job on a lathe involving like facing, outside turning, taper turning, step turning, radius making and parting-off.

4. To study different types of fitting tools and marking tools used in fitting practice.

5. To prepare a job made out of MS Flats, making saw – cut filling V-cut taper at the corners.

6. To prepare lay out on a metal sheet by making and prepare rectangular tray pipe shaped components e.g. funnel.

7. To prepare joints for welding suitable for butt welding and lap welding.

8. To study various types of carpentry tools and prepare simple types of at least two wooden joints.

9. To prepare simple engineering components/shapes by forging.

10. To prepare mold and core assembly.

11. To prepare horizontal surface/vertical surface/curved surface/slats or V-grooves on a shaper/planner.

12. To prepare a job involving side and face milling on a milling

13. To prepare a job on CNC Machine/Additive Manufacturing.

Note : At least eight experiments/jobs are to be performed/prepared by the students in the semester.

Gurugram University Scheme of Studies and Examination

Bachelor of Technology (SCHEME A2) Semester-2

Sr. No.	Course Code	Course Title	Hours per week			Total Contact Hrs. per week	Credit
			L	T	P		
1.	BSM-104	Mathematics-II	3	1	0	4	4
2.	HSV-102	Human Value & Soft Skills	2	0	2	4	3
3.	EEE-103 OR BSP-103	Basics of Electrical Engineering OR Physics	3 3	0 1	0 0	3 OR 4	3 OR 4
4.	CSE-102	Data Structure Using C	3	0	0	3	3
5.	CSE-106	Python Programming	3	0	0	3	3
6.	ECE-102	Electronics Engineering-I	3	0	0	3	3
7.	EEE-103P OR BSP-103P	Basics of Electrical Engineering (P) OR Physics (P)	0	0	2	2	1
8.	CSE-102P	Data Structure Using C (P)	0	0	2	2	1
9.	CSE-106P	Python Programming (P)	0	0	2	2	1
10.	ECE-102P	Electronics Engineering-I (P)	0	0	2	2	1
Total						**28 / 29**	**23/24**

Course code	BSM-104				
Category	Basic Science Course				
Course title	Mathematics-II				
Scheme and Credits	L	T	P	Credits	
	3	1	0	4	
Class work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Objectives of the course

4. Demonstrate their understanding of mathematical ideas from multiple perspectives.
5. To develop logical understanding of the subject
6. To develop mathematical skill so that students are able to apply mathematical methods & principals in solving problem from Engineering fields.
7. To make aware students about the importance and symbiosis between Mathematics and Engineering.

Unit-I

Ordinary Differential Equations: Exact differential equations, Equations reducible to exact differential equations, Applications of differential equations of first order & first degree to simple electric circuits, Newton's law of cooling, Heat flow and Orthogonal trajectories, Linear Differential equations of second and higher order, Complete solution, Complementary function and Particular integral, Method of variation of parameters to find particular integral, Cauchy's and Legendre's linear equations.

Unit-II

Laplace Transforms and its Applications: Laplace transforms of elementary functions, Properties of Laplace transforms, Existence conditions, Transforms of derivatives, Transforms of integrals, Multiplication by tn , Division by t, Evaluation of integrals by Laplace transforms, Laplace transform of unit step function, Unit impulse function and Periodic function, Inverse transforms.

Unit-III

Partial Differential Equations: Formation of partial differential equations, Lagrange' linear partial differential equation, First order non-linear partial differential equation, Charpit's method, Method of separation of variables

Unit-IV

Basic Statistics: Measures of Central tendency: Mean, Median, Mode, Measures of Dispersion, Moments, Skewness and Kurtosis, Moments, Variance of a sum, Correlation coefficient, Correlation and regression – Rank correlation; Curve fitting by the method of least squares-fitting of straight lines, second degree parabolas and more general curves.

Reference Books:

1) G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, Pearson Education.
2) Erwin kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
3) Ramana B.V., Higher Engineering Mathematics, Tata McGraw-Hill Publishing Company Limited.
4) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
5) N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications.
6) P. Sivaramakrishna Das and C. Vijyakumari, Engineering Mathematics, Pearson Education.
7) W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, Wiley India.
8) S. L. Ross, Differential Equations, Wiley India.
9) R. K, Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Narosa Publication House Private Limited

Course code	HSV-102				
Category	Humanities and Social Sciences				
Course title	Human Values and Soft Skills				
Scheme and Credits	L	T	P	Credits	
	2	0	2	3	
Class work/Practical	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Objectives of the course

a. The course aims at developing the desired English language skills of students of Engineering and Technology so that they become proficient in communication to excel in their professional lives. The course has been designed as to enhance their linguistic and communicative competence.
b. Understanding (Clarity) of Human Relationships and Family.
c. Exposure to Issues in Society and nature (larger manmade systems and Nature).

Unit: 1

Motivation and Objectives of Human Values Course, Purpose of Education, Complimentarily of skills and values, how the current education system falls short, Peers Pressure, Social Pressure In various dimensions of life, Concept of Competition and Time Management.

Unit: 2

Concept of Preconditioning, Concept of Natural Acceptance in Human Being, Understanding Relationships, Dealing with anger, Nine universal values in human relationships. Concept of prosperity, idea of Society, Idea of decentralization of politics, economics, education, justice etc., Its comparison with centralized systems, Balance in nature.

Unit: 3

Techniques of Good Writing , Writing self assessment tasks, Precis writing and note making. Paragraph and Essay writing, Article writing and summarizing

Unit: 4

Business Communication: Formal and Informal Letter writing, Statement of Purpose, Job application & CV (summary statement of academic & professional profiles) and Power point presentations through relevant slides.

English Lab Activity: Blog Writing/Creating a Newsletter, Script writing & enacting for a street play. Develop negotiating skills by using appropriate language of courtesy, Recording individual efforts and holding paired interactions and Group Discussions, Preparing and practising for Interviews.

Suggested reference books

Recommended Readings:

1. Bhatnagar, Nitin andMamtaBhatnagar.Communicative English for Engineers and Professionals.Pearson Education, 2013.
2. Swan, Michael.Practical English Usage. OUP, 1995.
3. Gangal, J.K. Practical Course in Spoken English. New Delhi: PHI Learning, 2015.
4. Konar,Nira. Communication Skills for Professionals. New Delhi: PHI Learning Pvt. Ltd., 2009.
5. Bansal, R.K. and J.B. Harrison. Spoken English. Orient Longman, 1983.
6. Sharma, Sangeeta and Binod Mishra. Communication Skills for Engineers and Scientists. Delhi: PHI Learning Pvt. Ltd., 20
7. Annie Leonard, `` The Story of Stuff,'' Free Press
8. Mohandas Karamchand Gandhi,`` The Story of My Experiments with Truth," Beacon Press
9. J Krishnamurthy,`` On Education," Official repository
10. Hermann Hesse ,`` Siddhartha," Bantam Books
11. ThichNhatHanh,`` Old Path White Clouds," Parallex Press
12. On Education - The Mother Aurobindo Ashram Publication

Course code	EEE-103				
Category	**Engineering Science Course**				
Course title	**Basics of Electrical Engineering**				
Scheme and Credits	L	T	P	Credits	
	3	**0**	**0**	3	
Class work	**30 Marks**				
Exam	**70 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Objectives of the course

To explain the laws used in the analysis of DC and AC circuits.
To explain the behavior of circuit elements in single-phase circuits.
To explain the construction and operation of transformers, DC generators and motors, Induction motors, and synchronous generators.

Unit: 1.
DC Circuits:
Concept of electrical fields, charge, current, voltage, energy and their inter relationships. Electrical networks elements (R, L and C), voltage and current sources (ideal & controlled), series and parallel circuits.

Classification of electrical networks, Ohm's law, Kirchhoff's law and their applications for network solutions (Nodal and Mesh Analysis), Source transformation, star delta conversion. Network theorems: Superposition theorem, Thevenin and Norton Theorems, Millman Theorem, maximum power transfer theorem, Substitution and Reciprocity theorems.

Unit: 2

Electrostatics: Electrostatics field, electric flux density, electric field strength, absolute permittivity, relative permittivity, capacitance and capacitor, composite dielectric capacitors, capacitors in series and parallel, energy stored in capacitors, charging and discharging of capacitors and time constant.

AC Fundamentals: Sinusoidal voltages and currents, their mathematical and graphical representation, concept of instantaneous, peak (maximum), average and R.M.S. values, frequency,
cycle, period, peak factor and form factor, phase difference, lagging, leading and in phase quantities and phasor representation. Rectangular and polar representation of phasors.

Unit: 3
AC Circuits: Study of Single phase series and parallel R-L, R-C, R-L-C circuits, concept of impedance and admittance for different combinations, wave form and relevant voltage current phasor diagrams.

Concept of active power, reactive power, apparent power, complex power, power factor and resonance in series and parallel RLC circuit. Q- factor and bandwith. Introduction to three- phase circuits.

Single phase transformers: Construction, principle of working, E.M.F. equation, voltage and current ratios. Losses, definition of regulation and efficiency, determination of these by direct loading method. autotransformers and dimmer stats

Unit: 4

Electrical Machines: Introduction, Generation of rotating magnetic fields. Construction and working of separately excited DC motor, Single-phase induction motor, Three-phase induction motor and Synchronous generators.

Safety measures: Electric Shock, Earthing and its types, Safety Precautions to avoid shock, and Working principle of Fuse and Miniature circuit breaker (MCB), Residual Current Circuit Breaker (RCCB).

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Suggested books:

2. E. Huges, "Electrical Technology", ELBS.

Suggested reference books

4. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
5. V. Del Toro, "Principles of Electrical engineering", PHI.
6. Basic Electrical Engineering, A.E. Fitzgerald , David Higginbotham 2009 , Arvin Grabel, Tata McGraw-Hill Publishing Company; 5th Edition.

Course code	BSP-103				
Category	**Basic Science Course**				
Course title	**Physics**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	
	3	**1**	**0**	**4**	
Class work	**30 Marks**				
Exam	**70 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Objectives of the course

4. To impart knowledge of basic concepts in applied physics
5. To enhance the analytical capability of the engineering students.
6. To givea balance account of the fundamentals of Physics as well as some of recent developments in this area best suited to the Engineering applications in different branches and to provide the knowledge and methodology necessary for solving problems in the field of engineering.

UNIT – I

Electrostatics in vacuum and linear dielectric medium

Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential Boundary conditions of electric field and electrostatic potential; energy of a charge distribution and its expression in terms of electric field. Electrostatic field and potential of a dipole. Bound charges due to electric polarization; Electric displacement; boundary conditions on displacement.

UNIT – II

Electromagnetism and Magnetic Properties of Materials

Laws of electrostatics, electric current and the continuity equation, laws of magnetism. Ampere's Faraday's laws. Maxwell's equations. Polarisation, permeability and dielectric constant, polar and non-polar dielectrics, applications of dielectric Magnetisation, permeability and susceptibility, classification of magnetic materials, ferromagnetism, magnetic domains and hysteresis, applications.

UNIT – III

Wave Optics and Lasers

Wave Optics: Huygens' principle, superposition of waves and interference of light by wave-front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer. Fraunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power.

Lasers: Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO), solid-state lasers (ruby, Neodymium), dye lasers; Properties of laser beams: mono-chromaticity.

UNIT – IV

Introduction to Solids and Semiconductors

Free electron theory of metals, Fermi level, density of statesin1, 2 and 3 dimensions, Bloch's theorem for particles in a periodic potential, Kronig-Penney model and origin of energy bands. Types of electronic materials: metals, semiconductors, and insulators. Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p -n junction.

Suggested reference books

12. E. Hecht, "Optics", Pearson Education
13. D. J. Griffiths, "Quantum mechanics", Pearson Education
14. B.G. Streetman, "Solid State Electronic Devices", Pearson Education
15. G. Main, "Vibrations and waves in physics", Cambridge University Press
16. H. J. Pain, "The physics of vibrations and waves", Wiley
17. A. Ghatak, "Optics", McGraw Hill Education,
18. O. Svelto, "Principles of Lasers", Springer Science & Business Media,
19. R. Robinett, "Quantum Mechanics", OUP Oxford
20. D. McQuarrie, "Quantum Chemistry", University Science Books
21. D. A. Neamen, "Semiconductor Physics and Devices", Times Mirror High Education Group, Chicago
22. E.S. Yang, "Microelectronic Devices", McGraw Hill, Singapore

Course code	CSE-102				
Category	Professional Core Course				
Course title	Data Structures Using C				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Unit: 1

Introduction

Fundamentals of pointers in C, pointer declaration, passing pointer to functions, pointers and arrays, dynamic memory allocation, Definition of Algorithm, Data Abstraction, Performance Analysis & Measurement, Files and related operations inC. Data Structures vs Data Types.

Searching and SortingTechniques

Searching techniques: Linear and Binary, Sorting techniques: Selection, Bubble, Insertion, Merge sort, Quicksort, List and Table Sorting.

Unit: 2

Linear Data Structures- I

Arrays: Definition of array, Array storage, sparse arrays; Transpose, addition, and multiplication of sparse matrices, Stacks and Queues and their applications, expression evaluation, A mazing problem; multiple stacks and queues in an array, Application of stacks recursion polish expression and their compilation conversion of infix expression to prefix and postfix expression, Tower of Hanoi problem.

Unit: 3

Linear Data Structures- II

Linked Lists; definition, allocation for stacks and queues. Examples of linked lists, polynomial addition, comparison of sequential and linked allocation of storage; inversion, concatenation & copying of the lists. Implementations in C language.

Doubly Linked List: Definition of circular and doubly linked list, header node, insertion and deletion, sparse matrix, representation using doubly linked lists. Examples for application of doubly linked lists; dynamic storage management; node structures,

routines for allocation and deallocation, generalized lists and recursive algorithms for copying and comparison oflists.

Unit: 4

Non Linear Data Structures

Trees, Basic concepts and definitions of a tree and binary tree and associated terminology, Binary tree traversal techniques, Binary tree representation of trees, transformation of trees into binary trees, some more operations on binary trees, Binary Search Trees, Heaps and heapsort, threaded binary trees, Graphs: Representation of graphs and their traversal, Minimum cost Spanning Trees.

BOOKS:

1.Seymour Lipschutz:Data Structures with C, Schaum's outline by TMH

1. E Horowitz and S. Sahni: Fundamentals of Data Structures in C, Second Edition, UniversitiesPress, Hyderabad.
2. R.B. Patel: Expert Data Structures in C, Khanna Publishers,2001.
3. R.L. Kruse: Data Structures & Program Design in C, PHI.
4. D.F. Knuth: The art of Computer Programming Vol 1, Narosa Publications,1985.
5. Byron S. Gottfried & J K Chhabra: Theory and Problems of Programming with C Language, SchaumSeries, TMH,2005.

Course code	CSE-106				
Category	Professional Core Course				
Course title	Python Programming				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Unit: 1

Introduction: Installing Python; basic syntax, interactive shell, editing, saving, and running a script; data types; variables, assignments; numerical types; arithmetic operators and expressions; Loops and selection statements, Control statements String manipulations: subscript operator, indexing, slicing a string; text files: reading/writing text and numbers from/to a file; creating and reading a formatted file

Unit: 2

Lists, dictionary and Design with functions: Basic list operators, replacing, inserting, removing an element; searching and sorting lists; dictionary literals, adding, and removing keys, accessing and replacing values; traversing dictionaries. Hiding redundancy, complexity; arguments and return values; Program structure and design. Recursive functions.

Unit: 3

Object Oriented concepts: Design with Classes persistence storage of objects, inheritance, polymorphism, operator overloading, exception handling, module, packages. Graphical User Interfaces: Terminal based and GUI based programs, Simple GUI-Based Programs, Windows and Window Components, Input and Output with Entry Fields, Defining and Using Instance Variables, Other Useful GUI Resources

Unit: 4

Advance concepts: Simple graphics and image processing, Turtle operations, Manipulating turtle screen, Drawing two dimensional shapes, examining an object attributes, Taking a random walk, Image processing: Image manipulation operations, properties of images.

Basics of panda and numpy, use of anaconda, How to create dashboard and overview of Django

Suggested books:

Allen B. Downey, “Think Python: How to Think like a Computer Scientist”, 2nd Edition, O’Reilly Publishers, 2016.

Karl Beecher, “Computational Thinking: A Beginner's Guide to Problem Solving and programming”, 1st Edition, BCS Learning & Development Limited, 2017.

Suggested reference books

1. Fundamentals of Python: First Programs, Kenneth Lambert, Course Technology, Cengage Learning, 2012.
2. Introduction to Computer Science Using Python: A Computational Problem-Solving Focus, By Charles Dierbach, John Wiley & Sons, December 2012

Course code	ECE-102				
Category	**Engineering Science Course**				
Course title	**Electronics Engineering -I**				
Scheme and Credits	L	T	P	Credits	
	3	**0**	**0**	3	
Class work	**30 Marks**				
Exam	**70 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Objectives of the course

To familiarize students to the electronics devices.

To introduce p-n junction theory, operation of the semiconductor devices and their use in basic electronic circuits.

To introduce BJT & FET, operation of the semiconductor devices and their use in basic electronic circuits.

Unit: 1

Conducting materials: Review of energy bands, description of materials, drift velocity, collision time, Mean free path, mobility, conductivity, relaxation time, factors affecting conductivity of materials, types of thermal conductivity, Wiedmann-Franz law, super conductivity, effect of magnetic field, conducting materials, applications.

Semiconductor characteristics: Review of Si and Ge as semiconducting materials, Continuity Equation, P-N junction, Drift & Diffusion, Diffusion & Transition capacitances of P-N junction. Introduction to p-n junction diode and its applications.

Unit: 2

P-N junction diode and its applications: Introduction to p-n junction diode and its applications. Half wave & full wave rectifiers. clipping circuits, clamping circuits, filter circuits, peak to peak detector and voltage multiplier circuits.

Some Special Devices: Zener diode, Photodiodes, photo detectors, solar cell, light emitting diodes, semiconductor lasers, and light emitting materials.

Unit: 3

Bipolar junction transistors: Fundamentals of BJT, BJT biasing :base bias, emitter feedback bias, collector feedback bias, voltage divider bias and its operation , BJT voltages and currents characteristics: CE, CB and CC, and DC & AC load line and bias point. Thermal stability, BJT as a switching circuits, transistor power dissipation.

Construction and working of SCR (semiconductor controlled rectifier), DIAC, TRIAC, IGBT,

Unit: 4

Field Effect Devices: JFET: basic Operation and characteristics, drain and transfer characteristics, pinch off voltage, parameters of JFET: Transconductance (gm), ac drain resistance (rd), amplification factor(μ) ,Small Signal Model & Frequency Limitations. MOSFET: basic operation, depletion and enhancement type, pinch-off voltage, Shockley equation and Small Signal Model of MOSFET, MOS capacitor. UJT: Introduction and its applications.
Brief introduction to Planar Technology for device fabrication.

Suggested books:

3. J. Millman and C. Halkias, Integrated Electronics, McGraw Hill, 2nd Edition, 2009.
4. A. Sedra and C. Smith, Microelectronic Circuits: Theory and Applications, Oxford University Press, 6th Edition, 2013

Suggested reference books

7. Boylestad and Nashelsky, "Electronic Devices and Circuit Theory" Pearson publishers, 10th Edition
8. Tyagi M.S., "Introduction to Semiconductor Materials and Devices", John Wiley & Sons, 1993.
9. Spencer and Ghausi, Introduction to Electronic Circuit Design, Pearson Education, 2003
10. A. Dutta, Semiconductor Devices and Circuits, Oxford University Press, ND 2008

Course code	EEE-103P				
Category	Engineering Science Course				
Course title	**Basics of Electrical Engineering (P)**				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Class work	50 Marks				
Exam	**50 Marks**				
Total	**100 Marks**				
Duration of Exam	03 Hours				

Note: At least 8 experiments are to be performed by the students.

List of Subject related Experiments:

1. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. (Resistors, Capacitors and Inductors)

2. Verification of Ohm's Law, Kirchhoff current and voltage laws

3. To measure the power in three phase circuits using two wattmeter method.

4. To verify Thevenin's and Norton theorems.

5. To verify Maximum power transfer and Superposition theorems.

6. To perform direct load test of a transformer and plot efficiency Vs load characteristic.

7. To perform O.C. and S.C. tests of a transformer.

8. Measurement of power in a 3-phase system by two wattmeter method.

9. Measurement of power by 3 voltmeter/3 Ammeter method.

10. To verify the resonance in R-L-C circuits.

11. 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.

12. Torque Speed Characteristic of shunt dc motor.

PHYSICS Lab

Course code	BSP-103P				
Category	**Basic Science Course**				
Course title	**Physics (P)**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	
	0	**0**	**2**	**1**	
Class work	**50 Marks**				
Exam	**50 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note: At least 8 experiments are to be performed by the students.

List of Subject related Experiments:

1. To find out wavelength of monochromatic light using Newton's ring experiment.
2. To find out wavelength of monochromatic light using Diffraction grating.
3. To find out wavelength of monochromatic light using Freshnel's bi-prism
4. To study interference phenomena using Michelson's Interferometer and to find out wavelength of monochromatic light.
5. To study Hall effect in semiconductors and measure the Hall coefficient.
6. To find frequency of AC mains using sonometer.
7. To study the magnetic properties of materials using B-H curve.
8. To study the Curies temperature of materials using Dielectric set up.
9. To verify the inverse square law with the help of a photovoltaic cell.
10. To determine Planks constant using photocell.
11. To study the characteristics of Solar cell and find out the fill factor.
12. To find temperature co-efficient of platinum using Callender Griffith bridge.
13. To study the forward and reverse characteristics of P-N junction diode.

Course code	CSE-102P				
Category	Professional Core Course				
Course title	Data Structures Using C (P)				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Class work	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: At least 8 experiments are to be performed by the students.

List of Subject related Experiments:

1. Write a program to search an element in a two-dimensional array using linear search.
2. Using iteration & recursion concepts write programs for finding the element in the array using Binary Search Method
3. Write a program to perform following operations on tables using functions only
(a) Addition (b) Subtraction (c) Multiplication (d) Transpose
4. Using iteration & recursion concepts write the programs for Quick Sort Technique
5. Write a program to implement the various operations on string such as length of string concatenation, reverse of a string & copy of a string to another.
6. Write a program for swapping of two numbers using 'call by value' and 'call by reference strategies.
7. Write a program to implement binary search tree.
8. (Insertion and Deletion in Binary search Tree)
9. Write a program to create a linked list & perform operations such as insert, delete, update, reverse in the link list
10. Write the program for implementation of a file and performing operations such as insert, delete, update a record in the file.
11. Create a linked list and perform the following operations on it
(a) add a node (b) Delete a node

Course code	CSE-106P				
Category	Professional Core Course				
Course title	Python Programming (P)				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Class work	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: At least 8 experiments are to be performed by the students.

List of Subject related Experiments:

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton‘s method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball using Pygame

Course Code	ECE-102P				
Category	Professional Core Course				
Course title	Electronics Engineering -I (P)				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Class work	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: At least 8 experiments are to be performed by the students.

Objective: To attain expertise in lab equipment handling and understanding the basic devices, their properties, characteristics in detail. Along with their practical usage in the circuit

1. Study of lab equipments and components: CRO, Multimeter, Function Generator, Power supply- Active, Passive Components & Bread Board.

2. Study of V-I Characteristics of Si and Ge Diodes

3. Study of Zener Diode Characteristics and Zener Diode as Voltage Regulator

4. Study of Half Wave and Full Wave Rectifiers

5. Study of Rectifiers with Filters

6. Study of BJT Characteristics

7. Study of FET Characteristics

8. Study of BJT Biasing

9. To plot V-I Characteristics of DIAC.

10. To draw V-I characteristics of TRIAC for different values of Gate Currents.

11. Study of Characteristic of silicon-controlled rectifier.

Gurugram University Scheme of Studies and Examination

Bachelor of Technology Semester 3

S.No.	Category	Course Code	Course Title	Hours per week			Credits	Marks for Sessional	Marks for End Term Examination	Total
				L	T	P				
1	PCC		Electrical Machine I	3	1	0	3	30	70	100
2	BSC		Mathematical and Computational Techniques	3	1	0	3	30	70	100
3	PCC		Digital Electronics	3	1	0	3	30	70	100
4	PCC		Network Analysis and Synthesis	3	1	0	3	30	70	100
5	PCC		Signals and System	3	0	0	3	30	70	100
6	PCC		Electromagnetic Field Theory	3	0	0	3	30	70	100
7	LC		Electrical Machine I Lab	0	0	2	1	50	50	100
8	LC		Mathematical and Computational Techniques Lab	0	0	2	1	50	50	100
9	LC		Digital Electronics Lab	0	0	2	1	50	50	100
10	LC		Network Analysis and Synthesis Lab	0	0	2	1	50	50	100
11	Non credit		Constitution of India *	2	0	0	-	30	70	100*
Total							**22**			**1000**

***Note:** The examination of the regular students will be conducted by the concerned college/Institute internally. Each student will be required to score a minimum of 40% marks to qualify in the paper. The marks will not be included in determining the percentage of marks obtained for the award of a degree.

ELECTRICAL MACHINE-I

Course Code					
Category	**Professional Core Courses**				
Course title	**Electrical Machine-I**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: III**
	3	**1**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

1. To learn about Magnetic field, circuits, force and torque.
2. To gain understanding of DC machine.
3. To see operation of DC machine in motoring and generating mode.
4. To understand transformer.

Unit-I

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.

Electromagnetic force and torque

B-H curve of magnetic materials; flux-linkage vs 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

Unit-II

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.

Unit-III

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. Losses, load testing and back-to-back testing of DC machines.

Unit-IV

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.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the concepts of magnetic circuits.
2. Basic understanding of electromagnetic force and torque.
3. Understand the operation of dc machines.
4. Analyse the differences in operation of different dc machine configurations.
5. Analyse single phase and three phase transformers circuits.
6. Develop basic knowledge of autotransformer.

Text / References

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
2. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.
3. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
4. P.S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
5. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

MATHEMATICAL AND COMPUTATIONAL TECHNIQUES

Course Code					
Category	**Basic Science Course**				
Course title	**Mathematical and Computational Techniques**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: III**
	3	**1**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:

1. To provide the numerical methods of solving the non-linear equations, interpolation, differentiation, and integration.
2. This course is an introduction to a broad range of numerical methods for solving mathematical problems that arise in Science and Engineering.
3. To provide solutions of a nonlinear equation.
4. The goal is to provide a basic understanding of the derivation, analysis, and use of these numerical methods

Unit-I

Interpolation by polynomials, error of the interpolating polynomial, piecewise linear and cubic spline interpolation. Numerical integration, Simpson rule, composite rules, error formulae, Gauss quadrature.

Unit-II

Solution of a system of linear equations, implementation of Gaussian elimination and Gauss Seidel methods, partial pivoting, row echelon form, LU factorization, Cholesky's method, ill conditioning, norms.

Unit-III

Solution of a nonlinear equation, bisection and secant methods. Newton-Raphson method, rate of convergence, solution of a system of nonlinear equations. Numerical solution of ordinary differential equations, Euler and Runge-Kutta methods, multistep methods, predictor-corrector methods, order of convergence,

Unit-IV

Finite difference methods, numerical solutions of elliptic, parabolic, and hyperbolic partial differential equations. Eigenvalue problem, power method, QR method, Gershgorin’s theorem. Exposure to software packages like MATLAB.

Course Outcomes:

1. Understand different numerical integration techniques, and numerically solve differential equations.
2. Understand interpolation by polynomials.
3. Perform various matrix computations and solve simultaneous linear equations.
4. Find solution of nonlinear equation.
5. Find roots of a transcendental equation using different methods.
6. Implement different interpolation schemes.

Text/Reference Books:

1. S. D. Conte and Carl de Boor, Elementary Numerical Analysis- An Algorithmic Approach (3rd Edition), McGraw-Hill, 1980.
2. C. E. Froberg, Introduction to Numerical Analysis (2nd Edition), Addison-Wesley, 1981
3. E. Kreyszig, Advanced engineering mathematics (8th Edition), John Wiley (1999).
4. Reena Garg, Advanced Engineering Mathematics, Khanna Book Publishing (2022).
5. K. E. Atkinson, An Introduction to Numerical Analysis (2nd edition), Wiley-India, 1989
6. R. Agor, Elements of Mathematical Analysis, Khanna Publishing House, 2015.
7. Erwin Kreyzig, Advanced Engineering, Mathematics

DIGITAL ELECTRONICS

Course Code					
Category	**Professional Core Courses**				
Course title	**Digital Electronics**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: III**
	3	**1**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:

1. To provide a comprehensive introduction to digital logic design leading to the ability to understand binary codes, binary arithmetic and Boolean algebra and its relevance to digital logic design.
2. To study number system and codes.
3. To design and analyze combinational circuits and synchronous sequential logic circuits.
4. To familiarize students with basics of digital logic families.

Unit-I

Number system and codes: Binary, octal, hexadecimal and decimal Number systems and their inter conversion, BCD numbers (8421-2421), gray code, excess–3 code, cyclic code, code conversion, ASCII, EBCDIC codes. Binary addition and subtraction, signed and unsigned binary numbers, 1's and 2's complement representation.

Unit-II

Boolean Algebra: Basic logic circuits: Logic gates (AND, OR, NOT, NAND, NOR, Ex-OR, Ex NOR and their truth tables,), Universal Gates, Laws of Boolean algebra, De-Morgan's theorem, Min term, Max term, POS, SOP, K Map, Simplification by Boolean theorems, don't care condition

Logic Families: Introduction to digital logic family such as RTL, DTL, TTL, ECL, CMOS, IIR, HTL etc., their comparative study, Basic circuit, performance characteristics, Wired logic, open collector output etc.

Unit-III

Combinational Logic: The Half adder, the full adder, subtractor circuit. Multiplexer demultiplexer, decoder, BCD to seven segment decoders, encoders.

Flip flop and Timing circuit: set-reset laches, D-flipflop, R-S flip-flop, J-K Flip-flop, Master slave Flip flop, edge triggered flip-flop, T flip-flop.

Unit-IV

Registers and Counters: Synchronous/Asynchronous counter operation, Up/down synchronous counter, application of counter, Serial in/Serial out shift register, Serial in/Serial out shift register, Serial in/parallel out shift register, parallel in/ parallel out shift register, parallel in/Serial out shift register, Bi-directional register.

Course outcomes:

1. To present a problem oriented introductory knowledge of Digital circuits and its applications.
2. Learn Number system and codes.
3. Study Boolean algebra and theorems
4. To focus on the study of electronic circuits
5. Design and analyze combinational circuits.
6. Design and analyze synchronous sequential logic circuits.

Text/Reference Books:

1. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill.
2. Digital Fundamentals by Morris and Mano, PHI Publication
3. Fundamental of digital circuits by A. ANANDKUMAR, PHI Publication

NETWORK ANALYSIS AND SYNTHESIS

Course Code					
Category	**Professional Core Courses**				
Course title	**Network Analysis and Synthesis**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: III**
	3	**1**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:

1. To give students knowledge of AC theorems
2. To make the students understand concepts of two port networks, and network synthesis.
3. To give the students a fair knowledge on the Laplace transforms
4. To understand filters.

Unit-I

Node and mesh analysis, matrix approach of network containing voltage & current sources and reactance's, source transformation and duality.

Network theorems: Superposition, reciprocity, Thevenin's, Norton's, Maximum power transfer, compensation and Tallegen's theorem as applied to A.C. circuits.

Unit-II

Trigonometric and exponential Fourier series: Discrete spectra and symmetry of waveform, steady state response of a network to non-sinusoidal periodic inputs, power factor, effective values, Fourier transform and continuous spectra, three phase unbalanced circuit and power calculation.

Unit-III

Laplace transforms and properties: Partial fractions, singularity functions, waveform synthesis, analysis of RC, RL, and RLC networks with and without initial conditions with Laplace transforms evaluation of initial conditions.

Unit-IV

Transient behavior, concept of complex frequency, driving points and transfer functions poles and zeros of immittance function, their properties, sinusoidal response from pole-zero locations, convolution theorem and two four port network and interconnections, behaviour of series and parallel resonant circuits, introduction to band pass, low pass, high pass and band reject filters.

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Understand basics electrical circuits with nodal and mesh analysis.
2. Appreciate electrical network theorems.
3. Understand Trigonometric and exponential Fourier series.
4. Apply Laplace transform for steady state and transient analysis.
5. Determine different network functions.
6. Appreciate the frequency domain techniques.

Text/Reference Books

1. Franklin F. Kuo, "Network Analysis and Synthesis," Wiley India Education, 2nd Ed., 2006.
2. Van, Valkenburg, "Network analysis," Pearson, 2019.
3. Sudhakar, A., Shyammohan, S. P., "Circuits and Network," Tata McGraw-Hill New Delhi, 1994.
4. A William Hayt, "Engineering Circuit Analysis," 8th Edition, McGraw-Hill Education.
5. A. Anand Kumar, "Network Analysis and Synthesis," PHI publication, 2019.

SIGNALS AND SYSTEMS

Course Code					
Category	**Professional Core Courses**				
Course title	**Signals and Systems**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: III**
	3	**0**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:

1. To bring the Continuous-time and Discrete-time concepts.
2. To understand types of signals and systems.
3. To impart knowledge about representation, properties and applications of systems and signals.
4. To impart knowledge about transforms and their applications to signals and systems.

Unit-I

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

Unit-II

Continuous time and discrete time Linear shift-invariant (LSI) systems in detail-the impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of linear shift invariant systems. System representation through differential equations and difference equations. Periodic and semi-periodic inputs to an LSI system, the notion of a frequency response and its relation to the impulse response, Fourier series representation, the Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality.

Unit-III

The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. The idea of signal space and Orthogonal bases of signals. Properties of DTFT and DFT.

The Sampling Theorem and its implications- Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold, and so on. Aliasing and its effects. Relation between continuous and discrete time systems

Unit-IV

The Laplace Transform for continuous time signals and systems- the notion of eigen functions of LSI systems, a basis of eigen functions, region of convergence, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. Generalization of Parseval's Theorem.

Advanced topics: time-frequency representation and the uncertainty principle, Short-time Fourier Transforms and wavelet transforms.

Course outcomes:

1. Identify the sources of signals, and systems in real life.
2. Characterize different types of signals and systems.
3. Represent continuous-time and discrete-time systems in different mathematical forms.
4. Analyse system behaviour using time and frequency domain techniques.
5. Analyze Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT).
6. Characterize Laplace transform

Text/Reference books:

1. R. Anand, Signals and Systems, Khanna Publishing House, 2019.
2. A.V. Oppenheim, A.S. Willsky and I.T. Young,"Signals and Systems", Prentice Hall, 1983.
3. R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems - Continuous and Discrete", 4th edition, Prentice Hall, 1998.
4. Papoulis, "Circuits and Systems: A Modern Approach", HRW, 1980.
5. B.P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, c1998.
6. Douglas K. Lindner, "Introduction to Signals and Systems", Mc-Graw Hill International Edition: c1999.

ELECTROMAGNETIC FIELD THEORY

Course Code					
Category	**Professional Core Courses**				
Course title	**Electromagnetic Field Theory**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: III**
	3	**0**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:

1. To introduce the basic mathematical concepts related to electromagnetic vector fields.
2. To impart knowledge on the concepts of electrostatics, electric potential, energy density and their applications.
3. To impart knowledge on the concepts of magneto statics, magnetic flux density, scalar and vector potential and its applications.
4. To impart knowledge on the concepts of Faraday ‘s law, induced emf and Maxwell ‘s equations.
5. To impart knowledge on the concepts of Concepts of electromagnetic waves and Transmission lines.

Unit-I

Transmission Lines- Equations of Voltage and Current on TX line, Propagation constant, Characteristic impedance and reflection coefficient, Impedance Transformation, Loss-less and Low Loss Transmission line and VSWR, Power transfer on TX line, Smith Chart, Admittance Smith Chart, Applications of transmission lines, Impedance Matching, Lossy transmission line, Problems on Transmission line, Types of transmission line.

Unit-II

Maxwell’s Equations- Basics of Vectors, Vector calculus, Basic laws of Electromagnetics, Maxwell's Equations, Boundary conditions at Media Interface.

Uniform Plane Wave- Uniform plane wave, Propagation of wave, Wave polarization, Pioncere's Sphere, Wave propagation in conducting medium, Wave propagation and phase velocity, Power flow and Poynting vector, Surface current and power loss in a conductor Plane Waves at a Media Interface- Plane wave in arbitrary direction,

Unit-III

Plane wave at dielectric interface, Reflection and refraction at media interface, Total internal reflection, Polarization at media interface, Reflection from a conducting boundary.

Waveguides- Parallel plane waveguide, Wave propagation in parallel plane waveguide, Analysis of waveguide general approach,

Unit-IV

Rectangular waveguide, Modal propagation in rectangular waveguide, Surface currents on the waveguide walls, Field visualization and Attenuation in waveguide, Attenuation in waveguide continued.

Radiation- Solution for potential function, Radiation from the Hertz dipole, Power radiated by hertz, dipole, thin linear antenna, Radiation Parameters of antenna, receiving antenna, Monopole and Dipole antenna, Fourier transform relation between current and radiation pattern.

Course outcomes:

1. Appreciate the importance of transmission lines and analyse transmission line problems.
2. Solve Maxwell’s equations to understand propagation of electromagnetic waves.
3. Analyse plane wave at dielectric interface.
4. Understand waveguides.
5. Analyse electromagnetic wave propagation in rectangular metallic waveguides and resonators.
6. Understand antenna characteristics, and design linear antennas and their arrays.

Text/Reference Books:

1. R.K. Shevgaonkar, „Electromagnetic Waves, Tata McGraw Hill India, 2005
2. R.L. Yadav, Electromagnetic Fields and Waves, Khanna Book Publishing, 2021
3. E.C. Jordan & K.G. Balmain, Electromagnetic waves & Radiating Systems, Prentice Hall, India
4. Narayana Rao, N: Engineering Electromagnetics, 3rd ed., Prentice Hall, 1997.
5. David Cheng, Electromagnetics, Prentice Hall

ELECTRICAL MACHINE I LAB

Course Code					
Category	**Laboratory Courses**				
Course title	**Electrical Machine I Lab**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: III**
	0	**0**	**2**	**1**	
Class Work	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Notes:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus

LIST OF EXPERIMENTS

1. To study conversion of 3 Phase to six phase using 3 single phase transformers.
2. To study three phase rectifiers and supply configuration in 3 phase.
3. To perform Sumpner's Back-to-back test on 1-phase transformers.
4. To study Parallel operation of two 1-phase transformers.
5. To perform load test on DC shunt generator.
6. To study Speed control of DC shunt motor.
7. To study Swinburne’s test of DC shunt motor.
8. To study Hopkinson’s test of DC shunt M/Cs.
9. To study Ward Leonard method of speed control.

Note:

1. Each laboratory group shall not be more than about 20 students.
2. To allow fair opportunity of practical hands-on experience to each student, each experiment may either done by each student individually or in group of not more than 3-4 students. Larger groups be strictly discouraged/disallowed.

Lab Outcomes:

At the end of this lab, students will demonstrate the ability to

1. Understand the concepts of magnetic circuits.
2. Basic understanding of electromagnetic force and torque.
3. Understand the operation of dc machines.
4. Analyse the differences in operation of different dc machine configurations.
5. Analyse single phase and three phase transformers circuits.
6. Develop basic knowledge of autotransformer.

MATHEMATICAL AND COMPUTATIONAL TECHNIQUES LABORATORY

Course Code					
Category	**Laboratory Courses**				
Course title	**Mathematical and Computational Techniques Laboratory**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: III**
	0	**0**	**2**	**1**	
Class Work	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note:

1. Each laboratory group shall not be more than about 20 students.
2. To allow fair opportunity of practical hands-on experience to each student, each experiment may either done by each student individually or in group of not more than 3-4 students. Larger groups be strictly discouraged/disallowed.

The course is intended to introduce simulation software like MATLAB, Scilab and other relevant software and study to learn virtual circuit and their response.

LIST OF EXPERIMENTS

1. Study of Introduction to MATLAB.
2. Study of basic matrix operations.
3. Program for curve fitting by least – square approximations.
4. Program for scan conversion of a straight line, a circle, an ellipse, a rectangle and an arc.
5. Program To solve linear equation by using Gauss - Seidal iteration method.
6. Program for finding roots of f(x)=0 by Newton Raphson method.
7. Program for finding roots of f(x)=0 by bisection method.
8. Program for solving numerical integration by Simpson's 1/3 rule.
9. Program for solving numerical integration by trapezoidal rule.
10. Program for solving ordinary differential equation by Euler's method.
11. Program for solving ordinary differential equation by Runge Kutta method.
12. To find the numerical solution of Laplace equation.

Lab Outcomes:

On completion of the course, students will be able to:

1. Understand appropriate numerical methods to solve algebraic and transcendental equations.
2. Implement appropriate numerical methods to approximate a function.
3. Implement appropriate numerical methods to solve a differential equation.
4. Implement appropriate numerical methods to evaluate a derivative at a value.
5. Implement appropriate numerical methods to solve a linear system of equations.
6. Implement various numerical methods for finding root(s).

DIGITAL ELECTRONICS LABORATORY

Course Code						
Category	**Laboratory Courses**					
Course title	**Digital Electronics Laboratory**					
Scheme	**L**	**T**	**P**	**Credits**	**Semester: III**	
	0	**0**	**2**	**1**		
Class Work	50 Marks					
Exam	50 Marks					
Total	100 Marks					
Duration of Exam	3Hrs					

Notes:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus

LIST OF EXPERIMENTS

1. To study of TTL gates – AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR.
2. To design and realize a given function using K-maps and verify its performance.
3. To verify the operation of multiplexer and Demultiplexer.
4. To verify the operation of comparator.
5. To verify the truth tables of S-R, J-K, T and D type flip flops.
6. To study FLIP-FLOP conversion.
7. To verify the operation of bi-directional shift register.
8. To design and verify the operation of 3-bit synchronous counter.
9. To design and verify the operation of synchronous UP/DOWN decade counter using
10. J K flip-flops and drive a seven-segment display using the same.
11. To design and verify the operation of asynchronous UP/DOWN decade counter using
12. J K flip-flops and drive a seven-segment display using the same.
13. To design a 4-bit shift register and verify its operation.

Note:

1. Each laboratory group shall not be more than about 20 students.
2. To allow fair opportunity of practical hands-on experience to each student, each experiment may either done by each student individually or in group of not more than 3-4 students. Larger groups be strictly discouraged/disallowed.

Lab outcomes:

At the end of this lab, student will be able to

1. To present a problem oriented introductory knowledge of Digital circuits and its applications.
2. Learn Number system and codes.
3. Study Boolean algebra and theorems
4. To focus on the study of electronic circuits
5. Design and analyze combinational circuits.
6. Design and analyze synchronous sequential logic circuits.

NETWORK ANALYSIS AND SYNTHESIS LABORATORY

Course Code					
Category	**Laboratory Courses**				
Course title	**Network Analysis and Synthesis Laboratory**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: III**
	0	**0**	**2**	**1**	
Class Work	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Notes:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus

(i) Group of students for practical should be 15 to 20 in number.

LIST OF EXPERIMENTS:

1. Introduction of circuit creation and simulation software like MATLAB etc.
2. Study of Transient response of RC, RL circuit.
3. To find the resonance frequency, Band width of RLC series circuit.
4. To calculate and verify "Z" and “Y” parameters and "ABCD" parameters of a two-port network.
5. To determine equivalent parameter of parallel-series, cascading and parallel connections of two port network.
6. To calculate and verify Compensation theorem and Tellegen’s theorem.
7. To synthesize a network of a given network function and verify its response.
8. To calculate and verify Maximum power transfer and Reciprocity theorem.

Note: Use appropriate Software or simulation tool for experiments.

Note:

1. Each laboratory group shall not be more than about 20 students.
2. To allow fair opportunity of practical hands-on experience to each student, each experiment may either done by each student individually or in group of not more than 3-4 students. Larger groups be strictly discouraged/disallowed.

Lab Outcomes:

At the end of this lab, students will demonstrate the ability to:

1. Understand basics electrical circuits with nodal and mesh analysis.
2. Appreciate electrical network theorems.
3. Understand Trigonometric and exponential Fourier series.
4. Apply Laplace transform for steady state and transient analysis.
5. Determine different network functions.
6. Appreciate the frequency domain techniques.

CONSTITUTION OF INDIA

Course Code					
Category	**Non-Credit**				
Course title	**Constitution of India**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: III**
	2	**0**	**0**	**0**	
Class Work	30				
Exam	70				
Total	100				
Duration of Exam	3Hrs				

Note: The examination of the regular students will be conducted by the concerned college/Institute internally. Each student will be required to score a minimum of 40% marks to qualify in the paper. The marks will not be included in determining the percentage of marks obtained for the award of a degree.

COURSE OBJECTIVE:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.
4. To learn procedure and effects of emergency, composition and activities of election commission and amendment procedure.

UNIT - I

Philosophy of Indian Constitution: Salient features of Indian Constitution, Preamble, and Nature of Indian Constitution, Procedure for amendment of the Constitution.

UNIT - II

Federal structure and distribution of legislative and financial powers between the Union and the States

UNIT - III

Organs of Governance: President – Qualification and Powers of the President, Governor- Qualification and Powers of Governor, Parliament: Composition, Qualifications and Disqualifications, Judiciary: Appointment, Tenure and Removal of Judges.

UNIT - IV

Fundamental Rights: Origin and development of Fundamental rights, Need for fundamental rights. Introduction to Rights to equality, right to freedom, right against exploitation, Right to freedom of religion, Cultural and Education rights and Fundamental duties.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to a revolution in India.
3. Exercise his fundamental rights in proper sense at the same time identifies his responsibilities in national building.
4. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
5. Discuss the passage of the Hindu Code Bill of 1956.
6. Analyse the Indian political system, the powers and functions of the Union, State and Local Governments in detail.

TEXT AND REFERENCE BOOKS:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S.N. Busi, Dr. B.R. Ambedkar framing of Indian Constitution, latest Edition
3. M.P. Jain, Indian Constitution Law, Lexis Nexis, latest edition
4. D.D. Basu, Introduction to Constitution of India, Lexis Nexis, latest edition.

Gurugram University Scheme of Studies and Examination

Bachelor of Technology Semester 4

S.No.	Category	Course Code	Course Title	Hours per week			Credits	Marks for Sessional	Marks for End Term Examination	Total
				L	T	P				
1	PCC		Transmission and Distribution	3	1	0	3	30	70	100
2	PCC		Electrical Machine II	3	1	0	3	30	70	100
3	PCC		Power Electronics	3	1	0	3	30	70	100
4	PCC		Electronic Measurement and Instrumentation	3	0	0	3	30	70	100
5	PCC		Electric Engineering Materials	3	0	0	3	30	70	100
6	BSC		Probability Theory and Stochastic Processes	3	1	0	3	30	70	100
7	LC		Transmission and Distribution Lab	0	0	2	1	50	50	100
8	LC		Electrical Machine II Lab	0	0	2	1	50	50	100
9	LC		Power Electronics Lab	0	0	2	1	50	50	100
10	LC		Electronic Measurement and Instrumentation Lab	0	0	2	1	50	50	100
11	Non credit		Scientific and Technical Writing Skills*	2	0	0	-	30	70	100*
Total							**22**			**1000**

***Note:** The examination of the regular students will be conducted by the concerned college/Institute internally. Each student will be required to score a minimum of 40% marks to qualify in the paper. The marks will not be included in determining the percentage of marks obtained for the award of a degree.

NOTE: At the end of 4th semester each student has to undergo Practical Training of 4/6 weeks in an Industry/Institute/ Professional Organization/Research Laboratory/ training centre etc. and submit typed report along with a certificate from the organization and its evaluation shall be carried out in the 5th Semester.

TRANSMISSION AND DISTRIBUTION

Course Code					
Category	**Professional Core Courses**				
Course title	**Transmission and Distribution**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: IV**
	3	**1**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:

1. To introduce the basic laws of Transmission and Distribution
2. To impart knowledge on the Structure and present-Day Scenario of a power system.
3. To impart knowledge on the concepts of transmission and distribution line parameters.
4. To impart knowledge on the concepts of mechanical design of transmission line.
5. To impart knowledge on the performance of transmission line.

Unit-I

INTRODUCTION: Evolution of Power Systems and Present-Day Scenario. Structure of a power system, Bulk Power Grids and Micro-grids, indoor and outdoor substations, equipment for substations, layout, auxiliary supply.
DISTRIBUTION SYSTEMS: Radial, ring mains and network distribution system, comparison of various types of ac and dc systems.

Unit-II

TRANSMISSION LINES: Calculation of line parameters, Ferranti effect, proximity effect.
PERFORMANCE OF LINES: models of short, medium and long transmission lines, performance of transmission lines, circle diagram, capacity of synchronous condenser, tuned lines, voltage control.

Unit-III

MECHANICAL DESIGN: Sag and stress calculations, effect of ice and wind, dampers.
INSULATORS: Types, insulating materials, voltage distribution over insulator string, equalizer ring.

Unit-IV

CABLES: Types of LV and HV cables, grading of cables, capacitance, ratings.
CORONA: Phenomenon, critical voltage, power loss, reduction in losses, radio-interference,
HVDC transmission – types of links, advantages and limitations.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand the basic laws of Transmission and Distribution
2. Knowledge about the Structure and present-Day Scenario of a power system.
3. Analyses of transmission and distribution line parameters.
4. Understand mechanical design of transmission line with skin effect and proximity effect.
5. Understand the various cables and insulators gradings as well as ratings.
6. To know the performance of transmission line.

Text/Ref. Books:

1. Power System Engg: I. J. Nagrath and D. P. Kothari (TMH)
2. Electrical Power Systems: C. L. Wadhwa (New Age International Pvt Ltd)
3. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education, 1994.
4. Elements of power system analysis: W. D. Stevenson (MGH)
5. Electric Power System: B. M. Weedy, John Wiley & Sons.
6. Transmission & Distribution of Electrical Engineering: H. Cotton.
7. Transmission & Distribution of Electrical Engineering: Westing House & Oxford Univ. Press, New Delhi.

ELECTRICAL MACHINES-II

Course Code					
Category	**Professional Core Courses**				
Course title	**Electrical Machines II**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: IV**
	3	**1**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:

1. To introduce the basic concepts of rotating magnetic fields.
2. To impart knowledge on the operation of ac machines.
3. To impart knowledge on the performance characteristics of ac machines
4. To impart knowledge on speed and torque characteristics of ac machine.
5. To impart knowledge on the motoring, generating and braking mode of ac machines.

Unit-I

Poly-phase Induction Motor: Constructional features, Principal of operation, production of rotating magnetic field, induction motor action, torque production, testing, development of equivalent circuit, performance characteristics, circle diagram, starting methods, double cage and deep bar motors.

Unit-II

Poly-phase Induction Motor: Methods of speed control - stator voltage control, stator resistance control, frequency control, rotor resistance control, slip power recovery control Induction Generator: Principle of operation, types and applications. Single Phase Induction motors: Double revolving field theory, cross field theory, different types of single-phase induction motors, circuit model of single-phase induction motor.

Unit-III

Synchronous Generator: Principle, construction of cylindrical rotor and salient pole machines, winding, EMF equation, Armature reaction, testing, model of the machine, regulation – synchronous reactance method, Potier triangle method. Output power equation, power angle curve.

Unit-IV

Three Phase Synchronous Generators: Transient and sub-transient reactance, synchronization, parallel operation.
Synchronous Motor: Principles of synchronous motor, power angle curve, V-curve, starting, damper winding, synchronous condenser, applications.

Course Outcomes: At the end of this course, students will demonstrate the ability to:

1. Understand the concepts of rotating magnetic fields.
2. Overview of construction of ac machines.
3. Understand the operation of ac machines.
4. Analyse performance characteristics of ac machines.
5. Impart knowledge on speed and torque characteristics of ac machine.
6. Prepare the students to have a basic knowledge about motoring, generating and braking mode of ac machines

Text/ reference books:

1. Principle of Electrical Machines, V K Mehta, Rohit Mehta, S Chand
2. Electric Machines, Ashfaq Hussain, Dhanpat Rai
3. Electric Machines: I.J.Nagrath and D.P. Kothari, TMH, New Delhi.
4. Generalized theory of Electrical Machines: P.S. Bhimbra(Khanna Pub.)
5. Electric Machinery, Fitzgerald and Kingsley, MGH.

POWER ELECTRONICS

Course Code						
Category	**Professional Core Courses**					
Course title	**Power Electronics**					
Scheme	**L**	**T**	**P**	**Credits**	**Semester: IV**	
	3	**1**	**0**	**3**		
Class Work	30 Marks					
Exam	70 Marks					
Total	100 Marks					
Duration of Exam	3Hrs					

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:

1. To introduce the basic of power switching device.
2. To impart knowledge on the concepts of Rectifiers and regulators.
3. To impart knowledge on the concepts of converters.
4. To impart knowledge on the concepts of inverter.
5. To impart knowledge on the concepts of cycloconverter.

Unit-I

Power switching devices

Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Protections, series and parallel connections, Firing circuit for thyristor; Voltage and current commutation of a thyristor; pulse transformer and opto-coupler.

AC REGULATORS: Types of regulators, equation of load current, calculation of extinction angle, output voltage equation, harmonics in load voltage.

Unit-II

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 and output wave shape and power factor.

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.

Unit-III

DC-DC boost converter:

Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

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

Unit-IV

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.

Cycloconverters:

Basic principle of frequency conversion, types of cycloconverter, non-circulating and circulating types of cycloconverters

Course Outcomes: At the end of this course students will demonstrate the ability to;

1. Understand the differences between signal level and power level devices.
2. Understand working of AC regulators.
3. Analyse controlled rectifier circuits.
4. Analyse the operation of DC-DC choppers.
5. Analyse the operation of voltage source inverters.

6. Analyse cycloconverters.

Text/References Books: -

1. M. H. Rashid, “Power electronics: circuits, devices, and applications”, Pearson Education India, 2009.
2. N. Mohan and T. M. Undeland, “Power Electronics: Converters, Applications and Design”, John Wiley & Sons, 2007.
3. R. W. Erickson and D. Maksimovic, “Fundamentals of Power Electronics”, Springer Science & Business Media, 2007.
4. L. Umanand, “Power Electronics: Essentials and Applications”, Wiley India, 2009.

ELECTRONIC MEASUREMENT AND INSTRUMENTATION

Course Code					
Category	**Professional Core Courses**				
Course title	**Electronic Measurement and Instrumentation**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: IV**
	3	**0**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:

1. To introduce Electronics Instruments and Measurement providing an in-depth understanding of Measurement errors.
2. Digital Storage Oscilloscope, Function Generator and Analyzer, Display devices, Data acquisition systems and transducers.
3. To address the underlying concepts and methods behind Electronics measurements.
4. To introduce signal conditioning.

Unit-I

OSCILLOSCOPE: Block diagram, study of various stages in brief, high frequency CRO considerations. Sampling and storage oscilloscope.

GENERATION and ANALYSIS OF WAVEFORMS: Block diagram of pulse generators, signal generators, function generators wave analysers, distortion analysers, spectrum analyser, Harmonic analyser, introduction to power analyser.

Unit-II

ELECTRONIC INSTRUMENTS: Instruments for measurement of voltage, current and other circuit parameters, Q meters, R.F. Power measurements, introduction to digital meters.

FREQUENCY and TIME MEASUREMENT: Study of decade counting Assembly (DCA), frequency measurements, period measurements, Universal counter, Introduction to digital meters.

Unit-III

DISPLAY DEVICES: Nixie tubes, LED's LCD's, discharge devices.

TRANSDUCERS: Classification, Transducers of types: RLC photocell, thermocouples etc. basic schemes of measurement of displacement, velocity, acceleration, strain, pressure, liquid level and temperature.

Unit-IV

INTRODUCTION TO SIGNAL CONDITIONING:

DC signal conditioning system, AC signal conditioning system, data acquisition and conversion system

Course Outcome:

1. Analyze the performance characteristics of each instrument
2. Illustrate basic meters such as voltmeters and ammeters.
3. Explain about different types of signal analyzers.
4. Explain the basic features of oscilloscope and different types of oscilloscopes
5. Identify the various parameters that are measurable in electronic instrumentation.
6. Employ appropriate instruments to measure given sets of parameters.

Text book:

1. A course in Electrical & Electronics Measurements & Instrumentation: A. K. Sawhney; Dhanpat Rai & Sons.

Reference books.

1. Electronics Instrumentation & Measurement Techniques: Cooper; PHI.

ELECTRICAL ENGINEERING MATERIALS

Course Code					
Category	**Professional Core Courses**				
Course title	**Electrical Engineering Materials**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: IV**
	3	**0**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:

1. To provide the Information of metal.
2. This course is an introduction to dielectric properties of material
3. This course is an introduction to magnetic properties of material
4. The goal is to provide a basic understanding of semiconductors.

Unit-I

Conductivity of Metal: Introduction, factors affecting the resistivity of electrical materials, motion of an electron in an electric field, Equation of motion of an electron, current carried by electrons, mobility, thermionic emission, photo electric emission, field emission, effect of temperature on electrical conductivity of metals, electrical conducting materials, thermal properties, thermal conductivity of metals, thermoelectric effects.

Unit-II

Dielectric Properties: Introduction, effect of a dielectric on the behavior of a capacitor, polarization, the dielectric constant of monatomic gases, dielectric losses, significance of the loss tangent, frequency and temperature dependence of the dielectric constant, dielectric properties of polymeric system, ionic conductivity in insulators, insulating materials, ferroelectricity, piezoelectricity

Unit-III

Magnetic properties of Materials: Introduction, Classification of magnetic materials, diamagnetism, paramagnetism, ferromagnetism, magnetization curve, the hysteresis loop, factors affecting permeability and hysteresis loss, common magnetic materials, magnetic resonance.

Unit-IV

Semiconductors: energy band in solids, conductors, semiconductors and insulators, types of semiconductors, Intrinsic semiconductors, impurity type semiconductor, diffusion, the Einstein relation, hall effect, thermal conductivity of semiconductors, electrical conductivity of doped materials.

Course outcome:

After the completion of the course, the students will be able to:

1. Learn the basics of metal.
2. Learn the basics of conductivity.
3. Realize the dielectric properties of materials.
4. Explain the importance of magnetic properties.
5. Explain the behavior of conductivity of metals and
6. Classify semiconductor material.

Text book:

1. Bhadra Prasad Pokharel and Nava Raj Karki, "Electrical Engineering Materials", Sigma offset Press, Kamaladi, Kathmandu, Nepal,2004.
2. R.C. Jaeger," Introduction to Microelectronic Fabrication- Volume IV", Addison Wesley publishing Company, Inc., 1988.
3. Kasap.S.O, Principles of electrical engineering materials and devices, McGraw Hill, NewYork,2000.
4. R. A. Colcaser and S. Diehl-Nagle," Materials and Devices for Electrical Engineers and Physicists, McGraw-Hill, New York, 1985.

Reference books

1. C.S.Indulkar and S. Thiruvengadam, S., “An Introduction to Electrical Engineering”
2. Kenneth G. Budinski,, “Engineering Materials: Prentice Hall of India, New Delhi

PROBABILITY THEORY AND STOCHASTIC PROCESSES

Course Code					
Category	**Basic Science Courses**				
Course title	**Probability Theory and Stochastic Processes**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: IV**
	3	**1**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:

1. To introduce the probability theory and random processes and illustrate these concepts with engineering applications.
2. To introduce random variables.
3. The course introduces the concept of Stochastic Processes.
4. To understand regression analysis.

Unit-I

Sets and set operations; Probability space; Conditional probability and Bayes theorem; Combinatorial probability and sampling models. Discrete random variables, probability mass function, probability distribution function, example random variables and distributions; Continuous random variables, probability density function, probability distribution function, example distributions

Unit-II

Joint distributions, functions of one and two random variables, moments of random variables; Conditional distribution, densities and moments; Characteristic functions of a random variable; Markov, Chebyshev and Chernoff bounds;

Unit-III

Random sequences and modes of convergence (everywhere, almost everywhere, probability, distribution and mean square); Limit theorems; Strong and weak laws of large numbers, central limit theorem. Random process. Stationary processes. Mean and covariance functions. Ergodicity. Transmission of random process through LTI. Power spectral density.

Unit-IV

Regression analysis (linear and non-linear), Confidence intervals, Hypothesis testing, Error analysis

Course Outcomes:

1. Develop understanding of basics of probability theory.
2. Understand random variables.
3. Identify different distribution functions and their relevance.
4. Apply the concepts of probability theory to different problems.
5. Extract parameters of a stochastic process and use them for process characterization.
6. Apply regression analysis.

Text/Reference Books:

1. H. Stark and J. Woods, `Probability and Random Processes with Applications to Signal Processing," Third Edition, Pearson Education
2. A.Papoulis and S. Unnikrishnan Pillai, ``Probability, Random Variables and Stochastic Processes," Fourth Edition, McGraw Hill.
3. K. L. Chung, Introduction to Probability Theory with Stochastic Processes, Springer International
4. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability, UBS Publishers,
5. S. Ross, Introduction to Stochastic Models, Harcourt Asia, Academic Press

TRANSMISSION AND DISTRIBUTION LABORATORY

Course Code						
Category	**Laboratory Courses**					
Course title	**Transmission and Distribution Laboratory**					
Scheme	**L**	**T**	**P**	**Credits**	**Semester: IV**	
	0	**0**	**2**	**1**		
Class Work	50 Marks					
Exam	50 Marks					
Total	100 Marks					
Duration of Exam	3Hrs					

Notes:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus

LIST OF EXPERIMENTS:

1. To study the Power System blocks in MATLAB.
2. To design short and long transmission line using MATLAB.
3. To study and calculate the transmission line parameters.
4. To study the corona loss in power distribution system.
5. To study the proximity and skin effect.
6. To find ABCD parameters of a model of transmission line.
7. To study performance of a transmission line under no load condition and under load at different power factors.
8. To observe the Ferranti effect in a model of transmission line.
9. To study performance characteristics of typical DC distribution system in radial and ring main configuration.
10. 10.To study mechanical design of transmission line.

Lab Outcomes:

At the end of the lab, students will demonstrate the ability to:

1. Understand the basic laws of Transmission and Distribution
2. Knowledge about the Structure and present-Day Scenario of a power system.
3. Analyses of transmission and distribution line parameters.
4. Understand mechanical design of transmission line with skin effect and proximity effect.
5. Understand the various cables and insulators gradings as well as ratings.
6. To know the performance of transmission line.

ELECTRICAL MACHINE II LABORATORY

Course Code						
Category	**Laboratory Courses**					
Course title	**Electrical Machine II Laboratory**					
Scheme	**L**	**T**	**P**	**Credits**	**Semester: IV**	
	0	**0**	**2**	**1**		
Class Work	50 Marks					
Exam	50 Marks					
Total	100 Marks					
Duration of Exam	3Hrs					

Notes:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus

LIST OF EXPERIMENTS:

1. To perform the open circuit test and block rotor test on 3 phase induction motor and draw the circle diagram.
2. To study the speed control of induction motor by rotor resistance control.
3. To conduct the load test to determine the performance characteristics of the I.M.
4. To compute the torque v/s speed characteristics for various stator voltages.
5. To perform the open circuit test and block rotor test on single-phase induction motor and determine equivalent circuit parameters.
6. To perform O.C. test on synchronous generator and determine the full load regulation of a three phase synchronous generator by synchronous impedance method.
7. To Study and Measure Synchronous Impedance and Short circuit ratio of Synchronous Generator .
8. Study of Power (Load) sharing between two Three Phase alternators in parallel operation Condition.
9. To plot V- Curve of synchronous motor.
10. Synchronization of two Three Phase Alternators by
    a) Synchroscope Method
    b) Three dark lamp Method
    c) Two bright one dark lamp Method
11. Determination of sequence impedances of synchronous machine for various stator voltages.

Note:

1. Each laboratory group shall not be more than about 20 students.
2. To allow fair opportunity of practical hands-on experience to each student, each experiment may either done by each student individually or in group of not more than 3-4 students. Larger groups be strictly discouraged/disallowed.

Lab Outcomes:

At the end of this lab, students will demonstrate the ability to:

1. Understand the concepts of rotating magnetic fields.
2. Overview of construction of ac machines.
3. Understand the operation of ac machines.
4. Analyse performance characteristics of ac machines.
5. Impart knowledge on speed and torque characteristics of ac machine.

POWER ELECTRONICS LABORATORY

Course Code						
Category	**Laboratory Courses**					
Course title	**Power Electronics Laboratory**					
Scheme	**L**	**T**	**P**	**Credits**	**Semester: IV**	
	0	**0**	**2**	**1**		
Class Work	50 Marks					
Exam	50 Marks					
Total	100 Marks					
Duration of Exam	3Hrs					

Notes:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus

LIST OF EXPERIMENTS

1. To Study Static Characteristics of Power Diode and Thyristor and to study reverse recovery of Power Diode and Thyristor.
2. To Study Characteristics of IGBT and MOSFET.
3. To study R, RC and UJT firing Circuit.
4. To Study of Pulse transformer and optocoupler technique
5. To Study of SCR Communication Technique Class, A-E.
6. To Study of AC voltage Regulator.
7. To control speed of small motor using Single Phase Half wave and Full wave fully controlled Converter
8. To control speed of a small DC motor using MOSFET based Chopper with output voltage control technique
9. To Study of Mc Murray - Bed ford Half and Full Bridge Inverter
10. To control speed of small AC induction motor using Single Phase non circulating type bridge by frequency conversion.
11. To Study single phase cycloconverter.

Note:

1. Each laboratory group shall not be more than about 20 students.
2. To allow fair opportunity of practical hands-on experience to each student, each experiment may either done by each student individually or in group of not more than 3-4 students. Larger groups be strictly discouraged/disallowed.

Lab Outcomes:

At the end of this lab, students will demonstrate the ability to;

1. Understand the differences between signal level and power level devices.
2. Understand working of AC regulators.
3. Analyse controlled rectifier circuits.
4. Analyse the operation of DC-DC choppers.
5. Analyse the operation of voltage source inverters.
6. Analyse cycloconverters/.

ELECTRONIC MEASUREMENT AND INSTRUMENTATION LABORATORY

Course Code						
Category	**Laboratory Courses**					
Course title	**Electronic Measurement and Instrumentation Laboratory**					
Scheme	**L**	**T**	**P**	**Credits**	**Semester: IV**	
	0	**0**	**2**	**1**		
Class Work	50 Marks					
Exam	50 Marks					
Total	100 Marks					
Duration of Exam	3Hrs					

Notes:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus.

(iii) Group of students for practical should be 15 to 20 in number.

LIST OF EXPERIMENTS

1. Study blocks wise construction of an analog oscilloscope and Function generator.
2. Study blocks wise construction of a Multimeter and frequency counter.
3. Study Measurement of different components and parameters like Q of a coil etc using LCRQ meter.
4. Study of distortion factor meter and determination of the % distortion of the given oscillator
5. Determine output characteristics of a LVDT and Measure displacement using LVDT
6. Study characteristics of temperature transducer like Thermocouple, Thermistor and RTD with implementation of a small project using signal conditioning circuits like instrumentation amplifier.
7. Measurement of Strain using Strain Guage.
8. To study differential pressure transducer and signal conditioning of output signal.
9. Measurement of level using capacitive transducer.
10. Study of Distance measurement using ultrasonic transducer.

Note:

1. Each laboratory group shall not be more than about 20 students.
2. To allow fair opportunity of practical hands-on experience to each student, each experiment may either done by each student individually or in group of not more than 3-4 students. Larger groups be strictly discouraged/disallowed.

Lab Outcome:

At the end of this lab, students will demonstrate the ability to;

1. Analyze the performance characteristics of each instrument
2. Illustrate basic meters such as voltmeters and ammeters.
3. Explain about different types of signal analyzers.
4. Explain the basic features of oscilloscope and different types of oscilloscopes
5. Identify the various parameters that are measurable in electronic instrumentation.
6. Employ appropriate instruments to measure given sets of parameters.

SCIENTIFIC AND TECHNICAL WRITING SKILLS

Course Code					
Category	**Non-Credit**				
Course title	**Scientific and Technical Writing Skills**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: IV**
	2	**0**	**0**	**0**	
Class Work	30				
Exam	70				
Total	100				
Duration of Exam	3Hrs				

Note: The examination of the regular students will be conducted by the concerned college/Institute internally. Each student will be required to score a minimum of 40% marks to qualify in the paper. The marks will not be included in determining the percentage of marks obtained for the award of a degree.

The following course content to conduct the activities is prescribed for the Scientific and Technical writing Skills Lab:

1. Activities on Writing Skills - Structure and presentation of different types of writing - letter writing/ Resume writing/ e-correspondence/ Technical report writing/ Portfolio writing - planning for writing - improving one's writing.
2. Activities on Presentation Skills - Oral presentations (individual and group) through JAM sessions/seminars/PPTs and written presentations through posters/ projects/ reports/ e-mails/ assignments etc.
3. Activities on Group Discussion and Interview Skills - Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and organization of ideas and rubrics for evaluation- Concept and process, pre-interview planning, opening strategies, answering strategies, interview through tele-conference and video-conferencing and Mock Interviews.

Text references:

1. A Course Book of Advanced Communication Skills (ACS) Lab published by Universities Press, Hyderabad.
2. Technical Communication by Meenakshi Raman & Sangeeta Sharma, Oxford University Press 2009.
3. Advanced Communication Skills Laboratory Manual by Sudha Rani, D, Pearson Education 2011.
4. Technical Communication by Paul V. Anderson, 2007. Cengage Learning pvt. Ltd. New Delhi.
5. Business and Professional Communication: Keys for Workplace Excellence, Kelly M. Quintanilla & Shawn T. Wahl. Sage South Asia Edition. Sage Publications, 2011.
6. The Basics of Communication: A Relational Prespective, Stev Duck & David T. Mc Mahan. Sage South Asia Edition. Sage Publications, 2012.
7. English Vocabulary in Use series, Cambridge University Press 2008.
8. Management Shapers Series by Universities Press (India) Pvt Ltd., Himayatnagar, Hyderabad 2008.
9. Handbook for Technical Communication by David A. McMurrey & Joanne Buckley, 2012. Cengage Learning.
10. Communication Skills by Leena Sen, PHI Learning Pvt Ltd., New Delhi, 2009.
11. Handbook for Technical Writing by David A McMurrey & Joanne Buckely CENGAGE Learning 2008.
12. Job Hunting by Colm Downes, Cambridge University Press 2008.
13. Master Public Speaking by Anne Nicholls, JAICO Publishing House, 2006.
14. English for Technical Communication for Engineering Students, Aysha Vishwamohan, Tata Mc graw Hill 2009.
15. Books on TOFEL/ GRE/ GMAT/ CAT/ IELTS by Barron's/ DELTA/ Cambridge University Press.
16. International English for Call Contres by Barry Tomalin and Suhashini Thomas, Macmillan Publishers, 2009.

Mini Project: As a part of Internal Evaluation

1. Seminar/ Professional Presentation
2. A Report on the same has to be prepared and presented.
    - Teachers may use their discretion to choose topics relevant and suitable to the needs of students.
    - Not more than two students to work on each mini project.
    - Students may be assessed by their performance both in oral presentation and written report.

Gurugram University Scheme of Studies and Examination

Bachelor of Technology Semester 5

S.No.	Category	Course Code	Course Title	Hours per week			Credits	Marks for Sessional	Marks for End Term Examination	Total
				L	T	P				
1	PCC		Power System I	3	1	0	3	30	70	100
2	PCC		Digital System Design	3	1	0	3	30	70	100
3	PCC		Communication Systems	3	1	0	3	30	70	100
4	PCC		Digital Signal Processing	3	1	0	3	30	70	100
5	PEC		Professional Elective I	3	0	0	3	30	70	100
6	OEC		Open Elective I	3	0	0	3	30	70	100
7	LC		Power System I Lab	0	0	2	1	50	50	100
8	LC		Digital System Design Lab	0	0	2	1	50	50	100
9	LC		Communication Systems Lab	0	0	2	1	50	50	100
10	LC		Digital Signal Processing Lab	0	0	2	1	50	50	100
11	PT		Practical Training-I	0	0	2	1	100	-	100
Total							**23**			**1100**

NOTE:

1. Choose any one from Professional Elective Course-I
2. Choose any one from Open Elective Course-I
3. **Practical Training-I:** The examination of the regular students will be conducted by the concerned college/Institute internally. Each student will be required to score a minimum of 40% marks to qualify in the paper. The marks will not be included in determining the percentage of marks obtained for the award of a degree.

PROFESSIONAL ELECTIVE- I (Semester-V)

Sr. No	Code	Subject	Credit
1.		Special Electrical Machine	3
2.		VLSI	3
3.		Nano Electronics	3
4.		High Speed Electronics	3
5.		Bio-Medical Electronics	3
6.		Power Quality	3

POWER SYSTEM I

Course Code					
Category	**Professional Core Courses**				
Course title	**Power System I**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: V**
	3	**1**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

1. To learn about power system.
2. To gain understanding of faults in power system.
3. To understand Switch gear and protection.
4. To learn about Solar and wind system.

Unit-I

Basic concepts: Introduction, Review of Three-phase systems. Analysis of simple three phase circuits. Single-phase representation of balance three-phase network, The one-line diagram and the impedance or reactance diagram, Per unit (PU) system, Complex power, The steady state model of synchronous machine, Transmission of electric power, Representation of loads.

Unit-II

Fault Analysis: Method of Symmetrical Components (positive, negative and zero sequences). Balanced and Unbalanced Faults. Representation of generators, lines and transformers in sequence networks. Computation of Fault Currents. Neutral Grounding.

Unit-III

Switchgear and protection: Types of Circuit Breakers. Attributes of Protection schemes, Back-up Protection. Protection schemes (Over-current, directional, distance protection, differential protection) and their application

Unit-IV

Introduction to DC Transmission and Solar PV System: 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 transmission.

Solar PV systems: I-V and P-V characteristics of PV panels, power 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.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the concepts of power systems.
2. Understand the various power system components.
3. Evaluate fault currents for different types of faults.
4. Understand basic protection schemes and circuit breakers.
5. Understand concepts of HVDC power transmission
6. Understand renewable energy generation.

Text/References:

1. J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education, 1994.
2. O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education, 1995.
3. R. Bergen and V. Vittal, “Power System Analysis”, Pearson Education Inc., 1999.
4. D. P. Kothari and I. J. Nagrath, “Modern Power System Analysis”, McGraw Hill Education, 2003.
5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “Electric Power Systems”, Wiley, 2012
6. EHV-AC/DC Transmission System; S. Rao: Khanna Pub.
7. C.L Wadhwa, “Electrical Power system” new age publication.

8. Transmission & Distribution of Electrical Engineering: Westing House & Oxford Univ. Press, New Delhi
9. Power System Protection & Switchgear by B. Ram, McGraw Hill

DIGITAL SYSTEM DESIGN

Course Code						
Category	**Professional Core Courses**					
Course title	**Digital System Design**					
Scheme	**L**	**T**	**P**	**Credits**	**Semester: V**	
	3	**1**	**0**	**3**		
Class Work	30 Marks					
Exam	70 Marks					
Total	100 Marks					
Duration of Exam	3Hrs					

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:

1. To know the basic language features of Verilog HDL and the role of HDL in digital logic design.
2. To know the behavioural modeling of combinational and simple sequential circuits.
3. To know the behavioral modeling of algorithmic state machines.
4. To know the synthesis of combinational and sequential descriptions.
5. To know the architectural features of programmable logic devices.

Unit-I

Hardware modeling with the Verilog HDL: Encapsulation, modeling primitives, Types of Modelling. Logic system, Data types and operators. Behavioral descriptions in Verilog HDL. Styles for Synthesis of combinational logic and sequential logic. HDL based Synthesis – Technology Independent design

Unit-II

System Verilog standards, Key System Verilog enhancements for hardware design. Advantages of System Verilog over Verilog, Data Types: Verilog data types, System Verilog data types, 2 - State Data types, Bit, byte, shortint, int, longint. 4 - State data types. Logic, Enumerated data types, User Defined data types, Struct data types, Strings, Packages, Type Conversion: Dynamic casting, Static Casting, Memories: Arrays, Dynamic Arrays, Multidimensional Arrays, Packed Arrays, Associative Arrays, Queues, Array Methods, Tasks and Functions: Verilog Tasks and Functions

Unit-III

Verilog interface signals - Limitations of Verilog interface signals, System Verilog interfaces, System Verilog port connections, Interface instantiation. Interfaces Arguments, Interface Modports, Interface References, Tasks and functions in interface, Verilog Event Scheduler, System Verilog Event Scheduler, Clocking Block, Input and Output Skews, Typical Testbench Environment, Verification plan

Unit-IV

Random Variables - rand and randc, Randomize ( ) Method - Pre/Post Randomize( ) methods, Constraints in the class, Rand mode and constraint mode, Constraint and Inheritance, Constraint Overriding, Set Membership, Distribution Constraints, Conditional Constraints - .implication (->), if/else, Inline Constraints

Course outcomes: After successful completion of the course, the students are able to

1. Demonstrate knowledge on HDL design flow, digital circuits design ,switch de-bouncing, metastability, memory devices applications
2. Can synthesis of combinational and sequential descriptions.
3. Design and develop the combinational and sequential circuits using behavioral modelling
4. Solving algorithmic state machines using hardware description language
5. Analyze the process of synthesizing the combinational and sequential descriptions
6. Memorizing the advantages of programmable logic devices and their description in Verilog

Text/Reference books:

1. Samir Palnitkar “Verilog HDLA Guide to Digital Design Synthesis, “2ndEdition, Pearson Education 2006.
2. Ashenden - Digital design,Elsevier
3. IEEE Standard VHDL Language Reference Manual latest edition
4. Digital Design and Modelling with VHDL and Synthesis: KC Chang; IEEE Computer Society Press.
5. "A VHDL Primmer”: Bhasker; Prentice Hall latest edition.
6. “Digital System Design using VHDL”: Charles. H.Roth ; PWS latest edition
7. "VHDL-Analysis & Modelling of Digital Systems”: Navabi Z; McGraw Hill.
8. VHDL-IV Edition: Perry; TMH latest edition
9. “Introduction to Digital Systems”: Ercegovac. Lang & Moreno; John Wiley latest edition
10. Fundamentals of Digital Logic with VHDL Design: Brown and Vranesic; TMH latest edition
11. Modern Digital Electronics- III Edition: R.P Jain; TMH latest edition.
12. Grout - Digital system Design using FPGA & CPLD 'S,Elsevier.

COMMUNICATION SYSTEMS

Course Code					
Category	**Professional Core Courses**				
Course title	**Communication Systems**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VI**
	3	**1**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

1. To introduce the students to the basics of different types of modulation techniques
2. To aim at a comprehensive coverage of design of radio transmitter and receiver
3. The course aims to make the student familiar with Digital Modulation and Demodulation techniques.
4. To understand Digital transmission, reception etc.

Unit-I

Course Contents: Review of signals and systems, Frequency domain of signals, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals.

Unit-II

Review of probability and random process. Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and Deemphasis, Threshold effect in angle modulation.
Pulse modulation. Sampling process. Pulse Amplitude and Pulse code modulation (PCM), Differential pulse code modulation. Delta modulation, Noise considerations in PCM, Time Division multiplexing, Digital Multiplexers.

Unit-III

Elements of Detection Theory, Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. Baseband Pulse Transmission- Inter Symbol Interference and Nyquist criterion.
Bandpass Digital Modulation schemes- Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying.

Unit-IV

Information Measures: Discrete Source models-Memoryless and Stationary, Mutual Information, Self-Information, Conditional Information, Average Mutual Information, Entropy, Entropy of block, Conditional Entropy, Information Measures for Analog Sources.

Course Outcomes:

At the end of this course, students will demonstrate the ability to;

1. Illustrate the principles of amplitude and angle modulation techniques
2. Understand probability and random process.
3. Analyze the performance of waveform coding techniques.
4. Compare bandpass digital modulation techniques for bit error rate, bandwidth and power requirements
5. Understand the concept of information rate and channel capacity.
6. Understand the concepts of information measure.

Text/Reference Books:

1. B.P.Lathi,Zhi Ding “Modern Digital and Analog Communication”, Oxford, 4th Edition,2011
2. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
3. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
4. Taub H. and Schilling D.L., "Principles of Communication Systems",Tata McGraw Hill, 2001.
5. Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill, 2000.
6. R. Anand, Communication Systems, Khanna Book Publishing Company, 2011.

DIGITAL SIGNAL PROCESSING

Course Code					
Category	**Professional Core Courses**				
Course title	**Digital Signal Processing**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: V**
	3	**1**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:

1. To describe signals mathematically and understand how to perform mathematical operations on signals.
2. Get familiarized with various structures of IIR and FIR systems.
3. To discuss word length issues, multi rate signal processing and application.
4. Design and realize various digital filters for digital signal processing.

Unit-I

Discrete time signals: Sequences; representation of signals on orthogonal basis; Sampling and reconstruction of signals; Discrete systems attributes, Z-Transform, Analysis of LSI systems, frequency Analysis, Inverse Systems,

Unit-II

Introduction to DFT: Efficient computation of DFT Properties of DFT – FFT algorithms – Radix-2 and Radix-4 FFT algorithms – Decimation in Time – Decimation in Frequency algorithms – Use of FFT algorithms in Linear Filtering and correlation.

Unit-III

Structure of IIR: System Design of Discrete time IIR filter from continuous time filter – IIR filter design by Impulse Invariance. Bilinear transformation – Approximation derivatives – Design of IIR filter in the Frequency domain. : Symmetric and Anti-symmetric FIR filters: Linear phase filter – Windowing techniques – rectangular, triangular, Blackman and Kaiser windows – Frequency sampling techniques – Structure for FIR systems.

Unit-IV

Finite word length effects in FIR and IIR digital filters: Quantization, round off errors and overflow errors. Multi rate digital signal processing: Concepts, design of practical sampling rate converters, Decimators, interpolators. Polyphase decompositions. Application of DSP – Model of Speech Wave Form – Vocoder.

Course Outcomes:

1. Interpret and analyze discrete time signals.
2. Compute Z transform.
3. Compute Discrete Fourier Transform.
4. Appreciate the importance of Fast Fourier Transform.
5. Design IIR and FIR filters.
6. Apply signal processing algorithms for real time applications.

Text Books

1. Digital Signal Processing A. Vallavaraj, C. Gnanapriya, and S. Salivahanan\
2. S.K. Mitra, Digital Signal Processing: A computer based approach.TMH
3. Oppenheim A V, Willsky A S and Young I T, “Signal & Systems”, Prentice Hall, (1983).
4. Ifeachor and Jervis, “Digital Signal Processing”, Pearson Education India.
5. DeFatta D J, Lucas J G and Hodgkiss W S, “Digital Signal Processing”, J Wiley and Sons, Singapore, 1988

SPECIAL ELECTRICAL MACHINES

Course Code					
Category	**Professional Elective Courses**				
Course title	**Special Electrical Machines**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: V**
	3	**0**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:

1. To describe Poly phase machines.
2. Get familiarized with various structures of induction motor.
3. To discuss Stepper motor.
4. Design and realize various permanent magnet machine.

Unit-I

POLY-PHASE AC MACHINES: Construction and performance of double cage and deep bar three phase induction motors, production of rotating magnetic field, induction motor action, e.m.f. induced in rotor circuit of slip ring induction motor, concept of constant torque and constant power controls, static slip power recovery control schemes (constant torque and constant power), stator voltage control, stator resistance control, frequency control, rotor resistance control, slip power recovery control, induction motor as an induction generator.

Unit-II

SINGLE-PHASE INDUCTION MOTORS: Construction, equivalent circuit, starting characteristics and applications of split phase, capacitor start, capacitor run, capacitor start capacitor-run and shaded pole motors.
SINGLE-PHASE COMMUTATOR MOTORS: Construction, principle of operation, characteristics of universal and repulsion motors; Linear Induction Motors. Construction, principle of operation, applications.
TWO PHASE AC SERVO MOTORS: Construction, torque-speed characteristics, performance and applications.

Unit-III

STEPPER MOTORS: Principle of operation, variable reluctance, permanent magnet and hybrid stepper motors, characteristics, drive circuits and applications.
SWITCHED RELUCTANCE MOTORS: Construction; principle of operation; torque production, modes of operation, drive circuits.

Unit-IV

PERMANENT MAGNET MACHINES: Permanent magnet dc motors, sinusoidal PM ac motors, brushless dc motors and their important features and applications, PCB motors. Single phase synchronous motor; construction, operating principle and characteristics of reluctance and hysteresis motors;

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

1. Impart knowledge on principle of operation and performance of all ac and dc machines with small and higher rating.
2. Understand the concepts of rotating magnetic fields.
3. Understand construction of all ac machines.
4. Analyze performance characteristics of ac machines.
5. Analyze torque and speed characteristics of all ac machines.
6. Prepare the students to have a basic knowledge about motoring, generating and braking mode of ac machines

Text/ reference books:

1. Principle of Electrical Machines, V K Mehta, Rohit Mehta, S Chand
2. Electric Machines, Ashfaq Hussain, Dhanpat Rai
3. Electric Machines: I. J. Nagrath and D.P. Kothari, TMH, New Delhi.

4. Generalized theory of Electrical Machines: P.S. Bhimbra (Khanna Pub.)
5. Electric Machinery, Fitzgerald and Kingsley, MGH.
6. P.C. Sen “Principles of Electrical Machines and Power Electronics” John willey& Sons, 2001
7. G. K. Dubey “Fundamentals of Electric Drives” Narosa Publishing House, 2001.

VLSI

Course Code					
Category	**Professional Elective Courses**				
Course title	**VLSI**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: V**
	3	**1**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:

1. To learn basic CMOS Circuits
2. To nurture students with CMOS analog circuit designs.
3. To realize importance of testability in logic circuit design.
4. To learn CMOS process technology.
5. To learn the concepts of designing VLSI Subsystems.

Unit-I

BASIC MOS TRANSISTOR: Enhancement mode and Depletion mode – Fabrication (NMOS, PMOS, CMOS, BiCMOS) Technology – NMOS transistor current equation – Second order effects – MOS Transistor Model.

Unit-II

NMOS and CMOS INVERTER AND GATES: NMOS and CMOS inverter – Determination of pull up / pull down ratios – Stick diagram – Lamda based rules – Super buffers – BiCMOS and steering logic.

Unit-III

SUB SYSTEM DESIGN and LAYOUT: Structured design of combinational circuits – Dynamic CMOS and clocking – Tally circuits – (NAND-NAND, NOR-NOR and AOI logic) – EXOR structure – Multiplexer structures – Barrel shifter.

Unit-IV

DESIGN OF COMBINATIONAL ELEMENTS and REGULAR ARRAY LOGIC: NMOS PLA – Programmable Logic Devices - Finite State Machine PLA – Introduction to FPGA.

VHDL PROGRAMMING: RTL Design – Combinational logic – Types – Operators – Packages – Sequential circuit – Sub-programs – Test benches. (Examples: address, counters, flipflops, FSM, Multiplexers / De-multiplexers).

Course outcomes:

1. Identify the various IC fabrication methods.
2. Express the Layout of simple MOS circuit using Lambda based design rules.
3. Apply the Lambda based design rules for subsystem design
4. Differentiate various FPGA architectures.
5. Design an application using Verilog HDL.
6. Concepts of modeling a digital system using Hardware Description Language.

Text/Reference books:

1. D. A. Pucknell, K. Eshraghian, ‘Basic VLSI Design’, 3rd Edition, Prentice Hall of India, New Delhi, 2003.
2. Introduction to Digital Integrated Circuits: Rabaey, Chandrakasan and Nikolic.
3. Principles of CMOS VLSI Design: Neil H.E. Weste and Kamran Eshraghian; Pearson.
4. N.H.Weste, ‘Principles of CMOS VLSI Design’, Pearson Education, India, 2002
5. VLSI Technology: S.M. Sze; McGraw-Hill.

NANO ELECTRONICS

Course Code					
Category	**Professional Elective Courses**				
Course title	**Nano Electronics**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: V**
	3	**0**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:

1. To understand various aspects of nano-technology and the processes involved in making nano components and material.
2. To leverage advantages of the nano-materials and appropriate use in solving practical problems.
3. To understand various aspects of nano-technology.
4. To understand the processes involved in making nano components and material.

Unit-I

Introduction to nanotechnology, applications of nano electronics. Basics of Quantum Mechanics: Wave nature of particles and wave-particle duality, Pauli Exclusion Principle, wave functions and Schrodinger's equations, Density of States, Band Theory of Solids, Particle in a box Concepts

Unit-II

Shrink-down approaches: CMOS scaling: advantages and limitations. Nanoscale MOSFETs, FINFETs, Vertical MOSFETs, system integration limits (interconnect issues etc.)

Unit-III

Nanostructure materials, classifications of nanostructure materials, zero dimensional, one dimensional, two dimensional and three dimensional, properties and applications Characterization techniques for nanostructured materials: SEM, TEM and AFM

Unit-IV

Nano electronics devices: Resonant Tunneling Diode, Coulomb dots, Quantum blockade, Single electron transistors, Carbon nanotube electronics, Band structure and transport, devices, applications, 2D semiconductors and electronic devices, Graphene, atomistic simulation

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

1. Understand various aspects of nano-technology.
2. Understand processes involved in making nano components and material.
3. Leverage advantages of the nano-materials and appropriate use in solving practical problems.
4. Understand various aspects of nano-technology and
5. Understand the processes involved in making nano components and material.
6. Analyse Nano Electronic devices.

Text/ reference books:

1. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, latest edition
2. W. Ranier, Nanoelectronics and Information Technology (Advanced Electronic Material and Novel Devices), Wiley-VCH, latest edition
3. K.E. Drexler, Nano systems, Wiley, latest edition
4. J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press, latest edition
5. C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, latest edition

HIGH SPEED ELECTRONICS

Course Code					
Category	**Professional Elective Courses**				
Course title	**High Speed Electronics**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: V**
	3	**0**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:

1. To Study the high-speed electronics system.
2. To Understand Radio frequency amplifiers.
3. To analyse mixers.
4. Learn the fabrication process.

Unit-I

Transmission line theory (basics) crosstalk and nonideal effects; signal integrity: impact of packages, vias, traces, connectors; non-ideal return current paths, high frequency power delivery, methodologies for design of high-speed buses; radiated emissions and minimizing system noise.

Unit-II

Noise Analysis: Sources, Noise Figure, Gain compression, Harmonic distortion, Inter - modulation, Cross-modulation, Dynamic range. Devices: Passive and active, Lumped passive devices (models), Active (models, low vs High frequency)

Unit-III

RF Amplifier Design, Stability, Low Noise Amplifiers, Broadband Amplifiers (and Distributed) Power Amplifiers, Class A, B, AB and C, D E Integrated circuit realizations, Cross-over distortion Efficiency RF power output stages.
Mixers –Up conversion Down conversion, Conversion gain and spurious response. Oscillators Principles. PLL Transceiver architectures.

Unit-IV

Printed Circuit Board Anatomy, CAD tools for PCB design, Standard fabrication, Microvia Boards. Board Assembly: Surface Mount Technology, Through Hole Technology, Process Control and Design challenges.

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

1. Study the high-speed electronics system.
2. Understand significance and the areas of application of high-speed electronics circuits.
3. Understand the properties of various components used in high-speed electronics.
4. Understand Radio frequency amplifiers.
5. Analyse Mixers.
6. Design High-speed electronic system using appropriate components.

Text/ reference books:

1. Stephen H. Hall, Garrett W. Hall, James A. McCall “High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices”, August 2000, Wiley-IEEE Press.
2. Thomas H. Lee, “The Design of CMOS Radio-Frequency Integrated Circuits”, CambridgeUniversity Press, 2004, ISBN 0521835399.
1. Behzad Razavi, “RF Microelectronics”, Prentice-Hall 1998, ISBN 0-13-887571-5.
2. Guillermo Gonzalez, “Microwave Transistor Amplifiers”, 2nd Edition, Prentice Hall.
3. Kai Chang, “RF and Microwave Wireless systems”, Wiley.
4. R.G. Kaduskar and V.B.Baru, Electronic Product design, Wiley India, 2011

BIO-MEDICAL ELECTRONICS

Course Code					
Category	**Professional Elective Courses**				
Course title	**Bio-Medical Electronics**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: V**
	3	**0**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:

1. To understand concept of electronic systems design in Bio- medical applications.
2. To understand the biological process.
3. To understand non electrical parameter measurements.
4. To understand various Bio Medical Measuring Instruments and therapeutic equipments.

Unit-I

Physiology and Transducers

Brief introduction to human physiology: Cell and its structure; Resting and Action Potential; Nervous system: Functional organisation of the nervous system; Structure of nervous system, neurons; synapse; transmitters and neural communication; Cardiovascular system; respiratory system; Basic components of a biomedical system. Biomedical transducers: Transducers selection criteria; Piezoelectric; ultrasonic; displacement, velocity, force, acceleration, flow, temperature, potential, dissolved ions and gases; Temperature measurements; Fibre optic temperature sensors

Unit-II

Electro – Physiological Measurements

Bio-electrodes and Biopotential amplifiers for ECG, EMG, EEG, etc.: Limb electrodes; floating electrodes; pregelled disposable electrodes; Micro, needle and surface electrodes; Preamplifiers, differential amplifiers, chopper amplifiers; Isolation amplifier. ECG; EEG; EMG; ERG; Lead systems and recording methods

Unit-III

Non-Electrical Parameter Measurements

Measurement of blood temperature, pressure and flow; Cardiac output; Heart rate; Heart sound; Pulmonary function measurements; spirometer; Impedance plethysmography; Photo Plethysmography, Body Plethysmography

Unit-IV

Medical Imaging

Ultrasonic, X-ray and nuclear imaging: Radio graphic and fluoroscopic techniques; Computer tomography; MRI; Ultrasonography

Assisting And Therapeutic Equipments

Prostheses and aids: pacemakers, defibrillators, heart-lung machine, artificial kidney, aids for the handicapped; Safety aspects: safety parameters of biomedical equipments

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

1. Apply the concept of electronic systems design in Bio- medical applications.
2. Examine the practical limitations on the electronic components while handling bio- substances.
3. Evaluate and analyze the biological processes like other electronic processes.
4. Measure non electrical parameter.
5. Familiar the various Bio Medical Measuring Instruments and therapeutic equipments.
6. Aware of electrical safety of medical equipments

Text/ reference books:

1. W.F. Ganong, Review of Medical Physiology, latest edition, Medical Publishers

2. J.G. Websster, ed., Medical Instrumentation, Houghton Mifflin, latest edition
3. A.M. Cook and J.G. Webster, eds., Therapeutic Medical Devices, Prentice-Hall, latest edition
4. R.S.Khander, Handbook of Biomedical Instrumentation‖, TATA Mc Graw-Hill, New Delhi, latest edition
5. Leslie Cromwell, ―Biomedical Instrumentation and Measurement, Prentice Hall of India, New Delhi, latest edition

POWER QUALITY

Course Code					
Category	**Professional Elective Courses**				
Course title	**Power Quality**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: V**
	3	**0**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:

1. To understand the various power quality phenomenon, their origin and monitoring and mitigation methods.
2. To understand the effects of various power quality phenomena in various equipments and distinguish between the various categories of power quality problems.
3. To understand the root of the power quality problems in industry and their impact on performance and economics.
4. To apply appropriate solution techniques for power quality mitigation based on the type of problem.
5. To understand importance of grounding and power distribution protection techniques on voltage quality.

Unit-I

Introduction to Power Quality: Terms and definitions of transients, Long Duration Voltage Variations: Under Voltage and Sustained Interruptions; Short Duration Voltage Variations: Interruption, Voltage Sag, Voltage Swell; Voltage Imbalance; Notching; D C offset; Waveform distortion; Voltage fluctuation; Power frequency variations.

Unit-II

Voltage Sag: Sources of voltage sag: Motor starting, Arc furnace, Fault clearing; Estimating voltage sag performance and principle of its protection; Solutions at end user level: Isolation Transformer, Voltage Regulator, Static UPS, Rotary UPS, Active Series Compensator.

Unit-III

Electrical Transients: Sources of Transient Over voltages- Atmospheric transients; Switching transients: Motor starting transients, PF correction capacitor switching transients, UPS switching transients; Neutral voltage swing; Devices for over voltage protection.
Harmonics: Causes of harmonics; Current and Voltage harmonics; Measurement of Harmonics; Effects of harmonics on – Transformers, AC motors, Capacitor banks, Cables, and Protection devices, Energy metering and Communication lines; Harmonic mitigation techniques.

Unit-IV

Measurement and Mitigation of Power Quality Problems: Power quality measurement devices: Harmonic Analyzer, Transient Disturbance Analyzer, Wiring and Grounding tester, Flicker meter, Oscilloscope, Multi-meter; Introduction to Custom Power Devices - Network reconfiguration devices; Load compensation and Voltage regulation using DSTATCOM; Protecting sensitive loads using DVR; Unified Power Quality Conditioner (UPQC).

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

1. Understand the various power quality phenomenon, their origin and monitoring and mitigation methods.
2. Understand the effects of various power quality phenomena in various equipments and distinguish between the various categories of power quality problems.
3. Understand the root of the power quality problems in industry and their impact on performance and economics.
4. Apply appropriate solution techniques for power quality mitigation based on the type of problem.
5. Understand importance of grounding on power quality.
6. Explain power distribution protection techniques and its impact on voltage quality.

Text/ reference books:

1. Roger C Dugan, McGrahan, Santoso & Beaty, “Electrical Power System Quality” McGraw Hill

2. Arinthom Ghosh & Gerard Ledwich, “Power Quality Enhancement Using Custom Power Devices” Kluwer Academic Publishers
3. C. Sankaran, “Power Quality” CRC Press.
4. Francisco C. De La Rosa, “Harmonics and Power Systems” CRC Publication
5. Ambrish Chandra, Bhim Singh, and Kamal Al-Haddad,” Power Quality: Problems and Mitigation Techniques” Wiley publication

POWER SYSTEM I LABORATORY

Course Code					
Category	**Laboratory Courses**				
Course title	**Power System I Laboratory**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: V**
	0	**0**	**2**	**1**	
Class Work	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Notes:

1. At least 10 experiments are to be performed by students in the semester.
2. At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus

LIST OF EXPERIMENTS:

(A) Hardware Based:

1. To determine negative and zero sequence reactances of an alternator.
2. To determine fault current for L-G, L-L, L-L-G and L-L-L faults at the terminals of an alternator at very low excitation
3. To study the IDMT over current relay and determine the time current characteristics
4. To study percentage differential relay
5. To study Impedance, MHO and Reactance type distance relays
6. To study ferranti effect and voltage distribution in H.V. long transmission line using transmission line model.
7. To study operation of oil testing set.
8. To understand PV modules and their characteristics like open circuit voltage, short circuit current, Fill factor, Efficiency,
9. To understand I-V and P-V characteristics of PV module with varying radiation and temperature level
10. To understand the I-V and P-V characteristics of series and parallel combination of PV modules.
11. To understand wind energy generation concepts like tip speed, torque and power relationship, wind speed versus power generation

(B) Simulation Based Experiments (using MATLAB or any other software)

12. To obtain steady state, transient and sub-transient short circuit currents in an alternator
13. To perform symmetrical fault analysis in a power system
14. To perform unsymmetrical fault analysis in a power system

Note:

1. Each laboratory group shall not be more than about 20 students.
2. To allow fair opportunity of practical hands-on experience to each student, each experiment may either done by each student individually or in group of not more than 3-4 students. Larger groups be strictly discouraged/disallowed.

Lab Outcomes:

At the end of this Lab, students will demonstrate the ability to

1. Understand the concepts of power systems.
2. Understand the various power system components.
3. Evaluate fault currents for different types of faults.
4. Understand basic protection schemes and circuit breakers.
5. Understand concepts of HVDC power transmission
6. Understand renewable energy generation.

DIGITAL SYSTEM DESIGN LABORATORY

Course Code					
Category	**Laboratory Courses**				
Course title	**Digital System Design Laboratory**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: V**
	0	**0**	**2**	**1**	
Class Work	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note:

1. At least 10 experiments are to be performed by students in the semester
2. At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus.
3. Group of students for practical should be 15 to 20 in number.

List of Experiments

Combinational and Sequential Design Exercises using FPGA (Spartan 3) and CPLD

1. Design of Half-Adder, Full Adder, Half Subtractor, Full Subtractor
2. Design a parity generator
3. Design a 4 Bit comparator
4. Design a RS and JK Flip flop
5. Design a 4: 1 Multiplexer
6. Design a 4 Bit Up / Down Counter with Loadable Count
7. Design a 3: 8 decoders
8. Design a 8 bit shift register
9. Design a arithmetic unit
10. Implement ADC and DAC interface with FPGA
11. Implement a serial communication interface with FPGA
12. Implement a Telephone keypad interface with FPGA
13. Implement a VGA interface with FPGA
14. Implement a PS2 keypad interface with FPGA
15. Implement a 4-digit seven segment display

Lab outcomes:

1. Identify the various IC fabrication methods.
2. Express the Layout of simple MOS circuit using Lambda based design rules.
3. Apply the Lambda based design rules for subsystem design
4. Differentiate various FPGA architectures.
5. Design an application using Verilog HDL.
6. Concepts of modeling a digital system using Hardware Description Language.

COMMUNICATION SYSTEMS LABORATORY

Course Code					
Category	**Laboratory Courses**				
Course title	**Communication Systems Laboratory**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VI**
	0	**0**	**2**	**1**	
Class Work	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Notes:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus

(iii) Group of students for practical should be 15 to 20 in number.

LIST OF EXPERIMENTS:

1. To study and waveform analysis of amplitude modulation and determine the modulation index of amplitude modulation.
2. To study and waveform analysis of amplitude demodulation by any method.
3. To study and waveform analysis of frequency modulation and determine the modulation index of frequency modulation.
4. To study and waveform analysis of frequency demodulation by any method.
5. To study Amplitude Shift Keying (ASK) modulation.
6. To study Frequency Shift Keying (FSK) modulation.
7. To study Phase Shift Keying (PSK) modulation.
8. To study and waveform analysis of phase modulation.
9. To study Phase demodulation.
10. To study Pulse code modulation.
11. To study Pulse amplitude modulation and demodulation.
12. To study Pulse width modulation.
13. To study Pulse position modulation.
14. To study delta modulation.
15. To deliver a seminar by each student on ADVANCE COMMUNICATION SYSTEMS.

Note: -

1. Total ten experiments are to be performed in the semester
2. At least seven experiments should be performed from the above list. Remaining three experiments should be performed as designed and set by the concerned institution as per the scope of the syllabus.

Lab Outcomes:

At the end of this lab, students will demonstrate the ability to;

1. Illustrate the principles of amplitude and angle modulation techniques
2. Understand probability and random process.
3. Analyze the performance of waveform coding techniques.
4. Compare bandpass digital modulation techniques for bit error rate, bandwidth and power requirements
5. Understand the concept of information rate and channel capacity.
6. Understand the concepts of information measure.

DIGITAL SIGNAL PROCESSING LABORATORY

Course Code						
Category	**Laboratory Courses**					
Course title	**Digital Signal Processing Laboratory**					
Scheme	**L**	**T**	**P**	**Credits**	**Semester: V**	
	0	**0**	**2**	**1**		
Class Work	50 Marks					
Exam	50 Marks					
Total	100 Marks					
Duration of Exam	3Hrs					

Notes:

1. At least 10 experiments are to be performed by students in the semester.
2. At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus.
3. Group of students for practical should be 15 to 20 in number.

List of Experiments

1. Introduction to MATLAB.
2. Represent basic signals (unit step, unit impulse, ramp, exponential, sine and cosine)
2. To develop program for Z-Transform in MATLAB
3. To develop program for Convolution of sequences in MATLAB
4. To develop program for Correlation of sequences in MATLAB
5. To develop program for DFT and IDFT of two sequences
6. To develop program for FFT of two Sequences
7. To develop program for Circular Convolution
8. To design analog filter (low-pass, high pass, band-pass, band-stop).
9. To design digital IIR filters (low-pass, high pass, band-pass, band-stop).
10. To develop program for Interpolation and Decimation of sequences
11. To design FIR filters using windows technique.
12. Detection of Signals buried in Noise
13. Effect of noise on signals in MATLAB

Lab Outcomes:

At the end of this lab, students will be able to

1. Interpret and analyze discrete time signals.
2. Compute Z transform.
3. Compute Discrete Fourier Transform.
4. Appreciate the importance of Fast Fourier Transform.
5. Design IIR and FIR filters.
6. Apply signal processing algorithms for real time applications.

PRACTICAL TRAINING-I

Course Code					
Category	**PT**				
Course title	**Practical Training-I**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: V**
	2	**0**	**0**	**0**	
Class Work	100				
Exam	-				
Total	100				
Duration of Exam	3Hrs				

Note: The examination of the regular students will be conducted by the concerned college/Institute internally. Each student will be required to score a minimum of 40% marks to qualify in the paper. The marks will not be included in determining the percentage of marks obtained for the award of a degree.

The students are required to undergo practical training of duration not less than 1.5 months in a reputed organization or concerned institute. The students who wish to undergo practical training, the industry chosen for undergoing the training should be at least a private limited company. The students shall submit and present the midterm progress report at the institute. the presentation will be attended by a committee. alternately the teacher may visit the industry to get the feedback of the student.

The final Viva voice of the practical training will be conducted by an external examiner and one external examiner appointed by the institute. External examiner will be from the panel of examiners submitted by the concerned institute approved by the board of studies in engineering and technology. Assessment of industrial training will be based on seminar, viva-voice, report and certificate of practical training obtained by the student from the industry or institute.

Gurugram University Scheme of Studies and Examination

Bachelor of Technology Semester 6

S.No.	Category	Course Code	Course Title	Hours per week			Credits	Marks for Sessional	Marks for End Term Examination	Total
				L	T	P				
1	PCC		Power System II	3	1	0	3	30	70	100
2	PCC		Control System	3	1	0	3	30	70	100
3	PCC		Microprocessors and Microcontrollers	3	1	0	3	30	70	100
4	PEC		Professional Electives II	3	0	0	3	30	70	100
5	PEC		Professional Electives III	3	0	0	3	30	70	100
6	OEC		Open Elective II	3	0	0	3	30	70	100
7	LC		Power System II Lab	0	0	2	1	50	50	100
8	LC		Control System Lab	0	0	2	1	50	50	100
9	LC		Microprocessors and Microcontrollers Lab	0	0	2	1	50	50	100
10	PROJ		Project-I	0	0	4	2	50	50	100
11	HSMC		Economics for Engineers*	2	0	0	-	30	70	100*
Total							**23**			**1000**

NOTE:

1. At the end of the 6th semester, each student has to undergo Practical Training of 4/6 weeks in an Industry/ Institute/ Professional Organization/ Research Laboratory/ training center etc. and submit the typed report along with a certificate from the organization and its evaluation shall be carried out in the 7th Semester.
2. Choose any one from each of the Professional Elective Course-II and III
3. Choose any one from Open Elective Course-II

PROFESSIONAL ELECTIVE- II (Semester-VI)

Sr. No	Code	Subject	Credit
1.		Robotics and Automation	3
2.		Energy Management and Auditing	3
3.		Introduction to MEMS	3
4.		Wireless Sensor Networks	3
5.		Mobile Communications	3

PROFESSIONAL ELECTIVE- III (Semester-VI)

Sr. No	Code	Subject	Credit
1.		Power Plant Engineering	3
2.		Power System Protection	3
3.		Electrical and Hybrid Vehicle	3
4.		Modelling and Analysis of Electrical Machines	3
5.		Electrical Safety and Standards	3

***Note:** The examination of the regular students will be conducted by the concerned college/Institute internally. Each student will be required to score a minimum of 40% marks to qualify in the paper. The marks will not be included in determining the percentage of marks obtained for the award of a degree.

POWER SYSTEM-II

Course Code					
Category	**Professional Core Courses**				
Course title	**Power System II**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VI**
	3	**1**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

1. To learn about power flow analysis.
2. To gain understanding of economics of power system.
3. To understand voltage and load frequency control.
4. To learn about power system stability.

Unit-I

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. Application of numerical methods for solution of nonlinear algebraic equations – Gauss Seidel and Newton-Raphson methods for the solution of the power flow equations.

Unit-II

Economic Operation of Power Systems: Distribution of loads between units within a plant. Distribution of loads between plants, Transmission loss equation, Classical Economic dispatch with losses. Optimal unit commitment problems and their solutions.

Unit-III

Voltage and Load Frequency Control: Introduction to control of active and reactive power flow, control of voltage, Excitation systems. Introduction to Load Frequency Control and Automatic generation control, Single area and modelling of AGC, Concept of multi area AGC.

Unit-IV

Power System Stability: Concepts, steady state and transient stability, swing equations, equal area criterion. Solution of Swing Equation, Transient stability algorithm using modified Euler's method and fourth order Runga Kutta method, – multi-machine stability analysis.

Course Outcomes:

At the end of this course, students will demonstrate the ability to;

1. Use numerical methods to analyse a power system in steady state.
2. Formulate Ybus and Zbus.
3. Apply load flow analysis on a power system.
4. Understand stability constraints in a synchronous grid.
5. Understand methods to control the voltage, frequency and power flow.
6. Understand the basics of power system economics

Text/References:

1. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994.
2. O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.
3. A. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 1999.
4. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003
5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley, 2012.

CONTROL SYSTEM

Course Code					
Category	**Professional Core Courses**				
Course title	**Control System**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: V**
	3	**1**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:

1. To understand concepts of the mathematical modeling, feedback control and stability analysis in Time and Frequency domains
2. To develop skills, to analyze feedback control systems in continuous- and discrete time domains.
3. To learn methods for improving system response transient and steady state behavior (response).
4. The compensator design of linear systems is also introduced.

Unit-I

Systems Components and Their Representation Control System: Terminology and Basic Structure-Feed forward and Feedback control theory-Electrical and Mechanical Transfer Function Models-Block diagram Models-Signal flow graphs models-DC and AC servo Systems-Synchronous -Multivariable control system

Unit-II

Time Response Analysis and Stability Concept Transient response-steady state response-Measures of performance of the standard first order and second order system-effect on an additional zero and an additional pole-steady error constant and system- type number-PID control.

Concept of stability-Bounded - Input Bounded - Output stability-Routh stability criterion- Relative stability-Root locus concept-Guidelines for sketching root locus.

Unit-III

Frequency Domain Analysis Bode Plot - Polar Plot- Nyquist Plots-Design of compensators using Bode Plots-Cascade lead compensation-Cascade lag compensation-Cascade lag-lead compensation

Unit-IV

Control System Analysis Using State Variable Methods State variable representation-Conversion of state variable models to transfer functions-Conversion of transfer functions to state variable models-Solution of state equations-Concepts of Controllability and Observability-Stability of linear systems-Equivalence between transfer function and state variable representations

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Understand the concepts of control systems and importance of feedback in control systems.
2. Perform signal flow graph and formulate transfer function.
3. Perform computations and solve problems on frequency response analysis.
4. Analyse Polar, Bode and Nyquist's plot.
5. Evaluate different types of state models and time functions.
6. Analyse different types of control systems like linear and non-linear control systems, etc.

Text/Reference Books:

2. Gopal. M., "Control Systems: Principles and Design", Tata McGraw-Hill, 1997
3. Ambikapathy A., Control Systems, Khanna Book Publications, 2019.
4. Kuo, B.C., "Automatic Control System", Prentice Hall, sixth edition, 1993.
5. Ogata, K., "Modern Control Engineering", Prentice Hall, second edition, 1991.
6. Nagrath and Gopal, "Modern Control Engineering", New Age International, New Delhi

MICROPROCESSORS AND MICROCONTROLLERS

Course Code					
Category	**Professional Core Courses**				
Course title	**Microprocessors and Microcontrollers**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VI**
	3	**1**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective:

The objectives of this course.

1. To develop an in-depth understanding of the operation of microprocessors and microcontroller.
2. To master the assembly language programming using concepts like assembler directives, procedures, macros, software interrupts etc.
3. To create an exposure to basic peripherals, its programming and interfacing techniques.
4. To understand the concept of Interrupts and interfacing details of 8086 and microcontroller.

Unit-I

THE 8086 MICROPROCESSOR

Introduction to 8086 — Microprocessor architecture — Addressing modes — Instruction set and assembler directives — Assembly language programming — Modular Programming — Linking and Relocation — Stacks — Procedures — Macros — Interrupts and interrupt service routines — Byte and String Manipulation.

Unit-II

8086 SYSTEM BUS STRUCTURE

8086 signals — Basic configurations — System bus timing –System design using 8086 — I/O programming — Introduction to Multiprogramming — System Bus Structure — Multiprocessor configurations — Coprocessor, closely coupled and loosely Coupled configurations — Introduction to advanced processors.

Unit-III

I/O INTERFACING

Memory Interfacing and I/O interfacing — Parallel communication interface — Serial communication interface — D/A and A/D Interface — Timer — Keyboard /display controller — Interrupt controller — DMA controller — Programming and applications Case studies: Traffic Light control, LED display, LCD display, Keyboard display interface and Alarm Controller.

Unit-IV

MICROCONTROLLER

Architecture of 8051 — Special Function Registers (SFRs) — I/O Pins Ports and Circuits — Instruction set — Addressing modes — Assembly language programming.

INTERFACING MICROCONTROLLER

Programming 8051 Timers — Serial Port Programming — Interrupts Programming — LCD and Keyboard Interfacing — ADC, DAC and Sensor Interfacing — External Memory Interface- Stepper Motor and Waveform generation — Comparison of Microprocessor, Microcontroller, PIC and ARM processors

Course Outcomes:

At the end of this course students will be able to:

1. Understand the fundamentals of Microprocessors.
2. Understand the internal design of 8051 microcontroller along with the features and their programming.
3. Competent with the on-chip peripherals of microcontrollers.
4. Design different interfacing applications using microcontrollers and peripherals.
5. Demonstrate the limitations and strengths of different types of microcontrollers and their comparison.
6. Build systems using microcontrollers for real time applications.

List of References:

1. Ramesh S. Gaonkar, “Microprocessor Architecture, Programming, and Applications with the 8085”, 5th Edition, Penram International, 2009.
2. Douglas Hall, “Microprocessor and Interfacing”, 2nd Edition, TMH, 2006.
3. Muhammad A. Mazidi, “The 8051 Microcontroller And Embedded Systems Using Assembly and C”, 2nd Edition., PHI, 2012.
4. Kenneth J. Ayala, “The 8051 Microcontroller”, 3rd Edition., Cengage Learning Publication, 2007.
5. Ajit Pal, “Microcontrollers: Principals and Applications”, 2nd Edition, PHI, 2011. 6. Datasheet of P89V51RD2

ROBOTICS AND AUTOMATION

Course Code					
Category	**Professional Elective Courses**				
Course title	**Robotics and Automation**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VI**
	3	**0**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

1. To learn about relationship between mechanical structures of industrial robots.
2. To gain understanding of spatial transformation to obtain forward kinematic equation of robot manipulators.
3. To understand inverse kinematics of simple robot manipulators.
4. To learn about Jacobian matrix and use it to identify singularities.

Unit-I

Introduction: Concept and scope of automation: Socio economic impacts of automation, Types of Automation, Low-Cost Automation
Fluid Power: Fluid power control elements, Standard graphical symbols, Fluid power generators, Hydraulic and pneumatic Cylinders - construction, design and mounting; Hydraulic and pneumatic Valves for pressure, flow and direction control.

Unit-II

Basic hydraulic and pneumatic circuits: Direct and Indirect Control of Single/Double Acting Cylinders, designing of logic circuits for a given time displacement diagram and sequence of operations, Hydraulic and Pneumatic Circuits using Time Delay Valve and Quick Exhaust Valve, Memory Circuit and Speed Control of a Cylinder, Troubleshooting and "Causes and Effects of Malfunctions" Basics of Control Chain, Circuit Layouts, Designation of specific Elements in a Circuit.
Fluidics: Boolean algebra, Truth Tables, Logic Gates, Coanda effect.

Unit-III

Electrical and Electronic Controls: Basics of Programmable logic controllers (PLC), Architecture and Components of PLC, Ladder Logic Diagrams
Transfer Devices and feeders: Classification, Constructional details and Applications of Transfer devices, Vibratory bowl feeders, Reciprocating tube, Centrifugal hopper feeders

Unit-IV

Robotics: Introduction, Classification based on geometry, control and path movement, Robot Specifications, Robot Performance Parameters, Robot Programming, Machine Vision, Teach pendants, Industrial Applications of Robots

Course Outcomes (COs): After studying this course, students will be able:

1. to demonstrate knowledge of the relationship between mechanical structures of industrial robots and
2. to learn robot's operational workspace characteristics.
3. to demonstrate an ability to apply spatial transformation to obtain forward kinematic equation of robot manipulators.
4. to learn PLC
5. to demonstrate an ability to solve inverse kinematics of simple robot manipulators.
6. to demonstrate an ability to obtain the Jacobian matrix and use it to identify singularities.

Text Books:

1. Anthony Esposito, Fluid Power with applications, Pearson
2. S. R Majumdar, Pneumatic Control, McGraw Hill
3. S. R Deb, Robotic Technology and Flexible Automation, Tata Mc Hill
4. Saeed B. Niku Introduction to Robotics, Wiley India
5. Ashitava Ghosal, Robotics, Oxford

ENERGY MANAGEMENT AND AUDITING

Course Code					
Category	**Professional Elective Courses**				
Course title	**Energy Management and Auditing**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VI**
	3	**0**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

1. To illustrate the concept energy management.
2. To introduce to energy audit study.
3. To study the basics of electrical energy management.
4. To learn about alternative energy.

Unit-I

Introduction: Introduction to energy management, Organizational Structure, Energy Policy and planning, Peak Demand controls, Methodologies, Types of Industrial Loads, Optimal Load Scheduling-Case studies.

Unit-II

Energy Auditing: Introduction, Energy Auditing Services, Basic Components of an Energy Audit, Specialized Audit Tools, Industrial Audits, Commercial Audits, Residential Audits, Indoor Air Quality and basics of economic analysis, cash flow model, time value of money, evaluation of proposals, pay-back method, average rate of return method, internal rate of return method, present value method, life cycle costing approach, Case studies.

Unit-III

Electric Energy Management: Introduction, Power Supply Effects of Unbalanced Voltages on the Performance of Motors, Power Factor, Electric motor Operating Loads, Determining Electric Motor Operating Loads, Power Meter, Slip Measurement, Electric Motor Efficiency, Sensitivity of Load to Motor RPM, Theoretical Power Consumption, Motor Efficiency Management, Motor Performance Management Process

Unit-IV

Alternative Energy: Introduction, Solar Energy, Wind Energy and other renewable resources for energy management.

Course Outcomes (COs): After studying this course, students will be able:

1. Understand the fundamentals of energy management systems.
2. Carry out various energy audit processes.
3. Describe Indoor Air Quality and basics of economic analysis
4. Understand various factors affecting performance of system.
5. Describe methods to improve efficiency of electrical energy systems.
6. Asses the use of alternative energy sources in improving the energy management

Text Books:

1. Wayne C. Turner, Steve Doty, Energy Management Handbook, The Fairmont Press, Inc.
2. Barney L. Capehart, Wayne C. Turner, William J. Kennedy, Guide to Energy Management, CRC Press.
3. Albert Thumann, William J. Younger, Handbook of Energy Audits, CRC Press, 2003.
4. Charles M. Gottschalk, Industrial energy conservation, John Wiley & Sons, 1996.
5. Craig B. Smith, Energy management principles, Pergamon Press.
6. D. Yogi Goswami, Frank Kreith, Energy Management and Conservation Handbook, CRC Press, 2007
7. G.G. Rajan, Optimizing energy efficiencies in industry -, Tata McGraw Hill, Pub. Co., 2001.
8. IEEE recommended practice for energy management in industrial and commercial facilities, IEEE std 739 - 1995
9. M Jayaraju and Premlet, Introduction to Energy Conservation and Management, Phasor Books, 2008
10. Paul O'Callaghan, Energy management, McGraw Hill Book Co.

INTRODUCTION TO MEMS

Course Code					
Category	**Professional Elective Courses**				
Course title	**Introduction to MEMS**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VI**
	3	**0**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

1. To illustrate the concept of micro/nanosystems.
2. To introduce to state-of-the-art lithography techniques for micro/nanosystems.
3. To study the new materials, science and technology for micro/nanosystem applications
4. To learn about state-of-the-art micromachining and packaging technologies.

Unit-I

Overview of MEMS and Microsystems: Introduction Microsystems vs. MEMS, Microsystems and Microelectronics, the Multidisciplinary Nature of Microsystems design and manufacture, Application of MEMS in various industries. MEMS and Miniaturization: Scaling laws in miniaturization: Introduction to Scaling, Scaling in Geometry, Rigid Body dynamics, Electrostatic forces, Electromagnetic forces, Electricity, Fluid Mechanics, Heat Transfer, Over view of Micro/Nano Sensors, Actuators and Systems.

Unit-II

Review of Basic MEMS fabrication modules: Oxidation, Deposition Techniques, Lithography (LIGA), and Etching. Micromachining: Surface Micromachining, sacrificial layer processes, Stiction; Bulk Micromachining, Isot ropic Etching and Anisotropic Etching, Wafer Bonding.

Unit-III

Mechanics of solids in MEMS/NEMS: Stresses, Strain, Hookes's law, Poisson effect, Linear Thermal Expansion, Bending; Energy methods.

Unit-IV

Overview of Finite Element Method, Modeling of Coupled Electromechanical Systems: electrostatics, coupled electro mechanics.

Course Outcomes (COs): After studying this course, students will be able:

1. Be introduced to the field of micro/nanosystems
2. Grain a knowledge of basic approaches for micro/nanosystem design
3. Gain a knowledge of state-of-the-art lithography techniques for micro/nanosystems.
4. Learn new materials, science and technology for micro/nanosystem applications.
5. Understand materials science for micro/nanosystem applications
6. Understand state-of-the-art micromachining and packaging technologies

Text Books:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, Micro and Smart Systems, Wiley India, 2012.
2. S. E. Lyshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano and Microengineering (Vol. 8). CRC press, (2005).
3. S. D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001.
4. M. Madou, Fundamentals of Microfabrication, CRC Press, 1997.
5. G. Kovacs, Micromachined Transducers Sourcebook, McGraw-Hill, Boston, 1998.
6. M.H. Bao, Micromechanical Transducers: Pressure sensors, accelerometers, and Gyroscopes, Elsevier, New York, 2000.

WIRELESS SENSOR NETWORKS

Course Code					
Category	**Professional Elective Courses**				
Course title	**Wireless Sensor Networks**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VI**
	3	**0**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

1. Understand the working principles of the Sensors.
2. Understand the protocols used in sensor networks.
3. Understand design principles of WSN.
4. Understand engineering sensor networks.

Unit-I

Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks, Mobile Adhoc Networks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks.

Unit-II

Routing protocols, MAC protocols: Classification of MAC Protocols, S-MAC Protocol, BMAC protocol, IEEE 802.15.4 standard and ZigBee

Unit-III

Dissemination protocol for large sensor network. Data dissemination, data gathering, and data fusion; Quality of a sensor network; Real-time traffic support and security protocols. Design Principles for WSNs, Gateway Concepts Need for gateway, WSN to Internet Communication, and Internet to WSN Communication

Unit-IV

Single-node architecture, Hardware components and design constraints, Operating systems and execution environments, introduction to TinyOS and nesC

Course Outcomes (COs): After studying this course, students will be able:

1. Design wireless sensor networks for a given application
2. Understand emerging research areas in the field of sensor networks
3. Understand MAC protocols used for different communication standards used in WSN
4. Understand large sensor network.
5. Understand architecture and hardware components.
6. Explore new protocols for WSN

Text Books:

1. Waltenegus Dargie , Christian Poellabauer, " Fundamentals Of Wireless Sensor Networks
2. Theory And Practice", By John Wiley & Sons Publications ,2011
3. Sabrie Soloman, "Sensors Handbook" by McGraw Hill publication. 2009
4. Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks", Elsevier Publications,2004
5. Kazem Sohrby, Daniel Minoli, "Wireless Sensor Networks": Technology, Protocols and Applications, Wiley-Inter science
5. Philip Levis, And David Gay "TinyOS Programming" by Cambridge University Press 2009

MOBILE COMMUNICATION

Course Code					
Category	**Professional Elective Courses**				
Course title	**Mobile Communication**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VI**
	3	**0**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

During the course, students will be made to learn to:

1. Understand the Cellular concepts.
2. Understand the digital modulation techniques.
3. Understand the mobility in Cellular Systems.
4. Understand GSM.

Unit-I

Cellular concepts- Cell structure, frequency reuse, cell splitting, channel assignment, handoff, interference, capacity, power control; Wireless Standards: Overview of 2G and 3G cellular standards.

Unit-II

Large scale signal propagation. Fading channels-Multipath and small-scale fading- Doppler shift, doppler spread, average and rms delay spread, coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading, average fade duration and level crossing rate.

Okumura Model, Hata Model, PCS Extension to Hata Model, Walfisch and Bertoni Model, Wideband PCS Microcell Model, Indoor Propagation Models-Partition losses (Same Floor), Partition losses between Floors, Log-distance path loss model.

Unit-III

Multiple access schemes-FDMA, TDMA, CDMA and SDMA. Modulation schemes- BPSK, QPSK and variants, QAM, MSK and GMSK, multicarrier modulation, OFDM and OFDMA.

Unit-IV

Mobility in Cellular Systems: The Gateway Concept, Measurement Reports, Mobility Procedures - Mobile IP: Basic Components, Tunneling

GSM: Architecture, – UMTS: Architecture, Basics of CDMA, - Introduction to LTE: History, Architecture - OFDM – Uplink and Downlink Communication in LTE.

Course Outcomes (COs): After studying this course, students will be able:

1. To understand the working principles of the mobile communication systems.
2. To understand the relation between the user features and underlying technology.
3. To analyze mobile communication systems for improved performance.
4. To understand multiple access schemes.
5. To analyze mobility in cellular systems.
6. To discuss GSM.

Text Books:

1. WCY Lee, Mobile Cellular Telecommunications Systems, McGraw Hill, 1990.
2. WCY Lee, Mobile Communications Design Fundamentals, Prentice Hall, 1993.
3. Raymond Steele, Mobile Radio Communications, IEEE Press, New York, 1992.
4. AJ Viterbi, CDMA: Principles of Spread Spectrum Communications, Addison Wesley, 1995.
5. VK Garg & JE Wilkes, Wireless & Personal Communication Systems, Prentice Hall, 1996.

POWER PLANT ENGINEERING

Course Code					
Category	**Professional Elective Courses**				
Course title	**Power Plant Engineering**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VI**
	3	**0**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

1. Acquaint the students to basic concepts of power plant.
2. To stimulate the students to think about power generation by renewable and non-renewable energy resources.
3. To acquaint the students to different types of power plant.
4. To Understand the principal components, efficiency and types of power plants.

Unit-I

Coal based thermal power plants, basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam and heating rates, subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems

Unit-II

Gas turbine and combined cycle power plants, Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems.

Unit-III

Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.

Unit-IV

Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

Course Outcomes:

Upon completion of the course students will be able to:

1. Understand the basics of Power Plants.
2. Understand the idea about the power generation by renewable and non-renewable energy resources.
3. Understand about the different types of cycles and natural resources used in power plants and their applications.
4. Understand the principal components and types of nuclear reactors.
5. Understand the principal components and types of hydro power plants.
6. Estimate different efficiencies associated with power plant systems.

Text Books:

1. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.
2. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.
3. Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998

POWER SYSTEM PROTECTION

Course Code					
Category	**Professional Elective Courses**				
Course title	**Power System Protection**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VI**
	3	**0**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

1. Acquaint the students to basic concepts of protection system.
2. To understand the protection schemes for different power system components.
3. To understand the basic principles of digital protection.
4. To understand system protection schemes, and the use of wide-area measurements.

Unit-I

Introduction and Components of a Protection System

Principles of Power System Protection, Relays, Instrument transformers, Circuit Breakers, Generator Protection: External and internal faults – differential protection – biased circulating current protection – self balance system – over-current and earth fault protection – protection against failure of excitation

Unit-II

Faults and Over-Current Protection

Review of Fault Analysis, Sequence Networks. Introduction to Overcurrent Protection and overcurrent relay co-ordination. Transformer protection: Differential protection – self-balance system of protection – overcurrent and earth fault protection – Buchholz's relay and its operation.

Unit-III

Equipment Protection Schemes

Directional, Distance, Differential protection. Bus bar Protection, Bus Bar arrangement schemes.

Modelling and Simulation of Protection Schemes

CT/PT modelling and standards, Simulation of transients using Electro-Magnetic Transients (EMT) programs. Relay Testing.

Unit-IV

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.

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the different components of a protection system.
2. Evaluate fault current due to different types of faults in a network.
3. Understand the protection schemes for different power system components.
4. Analyze model and simulation of protection schemes.
5. Understand the basic principles of digital protection.
6. Understand system protection schemes, and the use of wide-area measurements.

Text/References:

1. J. L. Blackburn, "Protective Relaying: Principles and Applications", Marcel Dekker, New York, 1987.
2. Y. G.Paithankar and S. R. Bhide, "Fundamentals of power system protection", Prentice Hall, India, 2010.
3. A. G. Phadke and J. S. Thorp, "Computer Relaying for Power Systems", John Wiley & Sons, 1988.
4. A. G. Phadke and J. S. Thorp, "Synchronized Phasor Measurements and their Applications", Springer, 2008.
5. D. Reimert, "Protective Relaying for Power Generation Systems", Taylor and Francis, 2006.

ELECTRICAL AND HYBRID VEHICLE

Course Code						
Category	**Professional Elective Courses**					
Course title	**Electrical and Hybrid Vehicle**					
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VI**	
	3	**0**	**0**	**3**		
Class Work	30 Marks					
Exam	70 Marks					
Total	100 Marks					
Duration of Exam	3Hrs					

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

1. Acquaint the students to basic concepts of electric and hybrid electric vehicles.
2. To understand the power electronics devices and electrical machines.
3. To understand the different energy storage devices.
4. To understand different configurations of electric vehicles.

Unit-I

ELECTRIC VEHICLES

Introduction, Components, vehicle mechanics – Roadway fundamentals, vehicle kinetics, Dynamics of vehicle motion - Propulsion System Design.

Unit-II

BATTERY

Basics – Types, Parameters – Capacity, Discharge rate, State of charge, state of Discharge, Depth of Discharge, Technical characteristics, Battery pack Design, Properties of Batteries.

Unit-III

DC and AC ELECTRICAL MACHINES

Motor and Engine rating, Requirements, DC machines, three phase A/c machines, Induction machines, permanent magnet machines, switched reluctance machines.

Unit-IV

ELECTRIC VEHICLE DRIVE TRAIN

Transmission configuration, Components – gears, differential, clutch, brakes regenerative braking, motor sizing.

HYBRID ELECTRIC VEHICLES

Types – series, parallel and series, parallel configuration – Design – Drive train, sizing of components.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Explain the basics of electric and hybrid electric vehicles.
2. Explain the architecture, technologies and fundamentals of EV.
3. Analyse the use of different power electronics devices and electrical machines in hybrid electric vehicles.
4. Explain the use of different energy storage devices used for hybrid electric vehicles, their technologies.
5. Explain the use of different control and select appropriate technology in EV.
6. Interpret working of different configurations of electric vehicles and its components, hybrid vehicle configuration, performance analysis and Energy Management strategies in HEVs.

Reference Books:

1. Iqbal Hussain, “Electric & Hybrid Vehicles – Design Fundamentals”, Second Edition, CRC Press, 2011.
2. Mehrdad Ehsani, Yimin Gao, Ali Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals”, CRC Press, 2010.
3. James Larminie, “Electric Vehicle Technology Explained”, John Wiley & Sons, 2003.
4. Sandeep Dhameja, “Electric Vehicle Battery Systems”, Newnes, 2000

MODELLING AND ANALYSIS OF ELECTRICAL MACHINES

Course Code						
Category	**Professional Elective Courses**					
Course title	**Modelling and Analysis of Electrical Machines**					
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VI**	
	3	**0**	**0**	**3**		
Class Work	30 Marks					
Exam	70 Marks					
Total	100 Marks					
Duration of Exam	3Hrs					

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

1. To provide a comprehensive exposure to electrical machine design.
2. To understand various design principles and magnetic circuits.
3. To work on detailed designs.
4. To know about various computer aided design.

Unit-I

GENERAL: General features and limitations of electrical machine design. Types of enclosures, heat dissipation, temperature rise heating and cooling cycles and ratings of machine machines. Cooling media used.
BASIC DESIGN PRINCIPLES: Output equation and output coefficient, Specific electric and magnetic loading. Effect of size and ventilation.

Unit-II

MAGNETIC CIRCUITS: MMF calculation for airgun and iron parts of electrical machines, gap contraction coefficient. Real and apparent flux densities. Estimation of magnet current of transformers and rotating machines, no load current of transformers and induction motors. Leakage flux and reactance calculations for transformers and rotating machines, Design of field magnet.

Unit-III

DETAILED DESIGN: Design of transformer, D.C. machines induction motor and synchronous machine and their performance calculations.

Unit-IV

COMPUTER AIDED DESIGN: Computerization of design Procedures. Development of Computer program and performance prediction. Optimization techniques and their applications to design Problems.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Describe electrical machine design.
2. Analyze and apply various design principles.
3. Understand magnetic circuits.
4. Carry out detailed design.
5. Carry out proper computer aided design.
6. Apply optimization technique to design problems.

Text books:

1. A course in Electrical Machine Design by A.K. Sawhney, Khanna Pub.

Reference books:

1. Theory, performance and Design of alternating current machines by MG Say, ELBS, 15th Ed. 1986.
2. Theory, Performance and Design of Direct Current machines by A.E. Clayton, 3rd Ed. 1967. Optimization Techniques, S.S. Rao

ELECTRICAL SAFETY AND STANDARDS

Course Code					
Category	**Professional Elective Courses**				
Course title	**Electrical Safety and Standards**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VI**
	3	**0**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

1. To provide a comprehensive exposure to electrical hazards.
2. To understand various grounding techniques and safety procedures
3. To understand various safety audit Electrical safety programme structure
4. To know about various electrical maintenance techniques

Unit-I

Primary and secondary hazards- arc, blast, shocks-causes and effects-safety equipment- flash and thermal protection, head and eye protection-rubber insulating equipment, hot sticks, insulated tools, barriers and signs, safety tags, locking devices- voltage measuring instruments- proximity and contact testers-safety electrical one line diagram electrician's safety kit.

Unit-II

General requirements for grounding and bonding- definitions- grounding of electrical equipment bonding of electrically conducting materials and other equipment-connection of grounding and bonding equipment- system grounding- purpose of system grounding- grounding electrode system grounding conductor connection to electrodes-use of grounded circuit conductor for grounding equipment- grounding of low voltage and high voltage systems.

Unit-III

The six step safety methods- pre job briefings - hot-work decision tree-safe switching of power system- lockout-tag out- flash hazard calculation and approach distances- calculating the required level of arc protection-safety equipment, procedure for low, medium and high voltage systems- the one minute safety audit Electrical safety programme structure, development- company safety team safety policy programme implementation- employee electrical safety teams- safety meetings- safety audit accident prevention- first aid-rescue techniques-accident investigation

Unit-IV

Safety related case for electrical equipments, Various Standards: IEEE, IEC, IS..., regulatory bodies national electrical safety code-standard for electrical safety in work place- occupational safety and health administration standards, Indian Electricity Acts related to Electrical Safety.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Describe electrical hazards and safety equipment.
2. Analyze and apply various grounding and bonding techniques
3. Select appropriate safety method for low, medium and high voltage equipment.
4. Understand various safety audit Electrical safety programme structure
5. Participate in a safety team.
6. Carry out proper maintenance of electrical equipment by understanding various standards.

Text/References

1. John Cadick, Mary Capelli-Schellpfeffer, Dennis Neitzel, Al Winfield,'Electrical Safety Handbook', McGraw-Hill Education, 4thEdition, 2012.
2. Sunil S. Rao, Prof. H.L. Saluja, "Electrical safety, fire safety Engineering and safety management", Khanna Publishers. New Delhi, 1988.

3. Maxwell Adams.J, ‘Electrical Safety- a guide to the causes and prevention of electric hazards’, The Institution of Electric Engineers, IET 1994.
4. Ray A. Jones, Jane G. Jones, ‘Electrical Safety in the Workplace’, Jones & Bartlett Learning, 2000.

POWER SYSTEM II LABORATORY

Course Code					
Category	**Laboratory Courses**				
Course title	**Power System II Laboratory**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VI**
	0	**0**	**2**	**1**	
Class Work	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Notes:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus

(iii) Group of students for practical should be 15 to 20 in number.

LIST OF EXPERIMENTS:

1. Draw the flow chart and develop the computer program for the formation of the Y Bus of a generalized network.
2. Draw the flow chart and develop the computer program for the formation of the Z Bus of a generalized network.
3. To plot the swing curve and observe the stability.
4. To perform load flow analysis using Gauss Seidel method.
5. To perform load flow analysis using Newton-Raphson method.
6. To study comparison of different load flow methods
7. To develop the program for stability analysis.
8. To observe transmission losses and efficiency with variations in power for the given example.
9. Simulation study on LFC of two area interconnected power system.
10. Simulation study on voltage control in multi area interconnected power system.

Note:

1. Each laboratory group shall not be more than about 20 students.
2. To allow fair opportunity of practical hands-on experience to each student, each experiment may either done by each student individually or in group of not more than 3-4 students. Larger groups be strictly discouraged/disallowed.

Lab Outcomes:

At the end of this lab, students will demonstrate the ability to;

1. Use numerical methods to analyse a power system in steady state.
2. Formulate Ybus and Zbus.
3. Apply load flow analysis on a power system.
4. Understand stability constraints in a synchronous grid.
5. Understand methods to control the voltage, frequency and power flow.
6. Understand the basics of power system economics

CONTROL SYSTEM LABORATORY

Course Code					
Category	**Laboratory Courses**				
Course title	**Control System Laboratory**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: V**
	0	**0**	**2**	**1**	
Class Work	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Notes:

(ii) At least 10 experiments are to be performed by students in the semester.

(iii) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus. Group of students for practical should be 15 to 20 in number.

LIST OF EXPERIMENTS: ANY SIX EXPERIEMENTS

1. To study speed Torque characteristics of
   a) A.C. servo motor
   b) DC servo motor.
2. (a) To demonstrate simple motor driven closed loop DC position control system.
   (b) To study and demonstrate simple closed loop speed control system.
3. To study the lead, lag, lead-lag compensators and to draw their magnitude and phase plots.
4. To study a stepper motor and to execute microprocessor or computer-based control of the same by changing number of steps, direction of rotation and speed.
5. To implement a PID controller for temperature control of a pilot plant.
6. To study behavior of 1st order, 2nd order type 0, type 1 system.
7. To study control action of light control device.
8. To study water level control using a industrial PLC.
9. To study motion control of a conveyor belt using an industrial PLC

SOFTWARE BASED (ANY FOUR EXPT.)

Introduction to SOFTWARE (Control System Toolbox)

10. Different Toolboxes in SOFTWARE, Introduction to Control Systems Toolbox.
11. Determine transpose, inverse values of given matrix.
12. Plot the pole-zero configuration in s-plane for the given transfer function. Plot unit step response of given transfer function and find peak overshoot, peak time.
13. Plot unit step response and to find rise time and delay time.
14. Plot locus of given transfer function, locate closed loop poles for different values of k.
15. Plot root locus of given transfer function and to find out S, Wd, Wn at given root and to discuss stability.
16. Plot bode plot of given transfer function and find gain and phase margins Plot the Nyquist plot for given transfer function and to discuss closed loop stability, gain and phase margin.

Note:

1. Each laboratory group shall not be more than about 20 students.
2. To allow fair opportunity of practical hands-on experience to each student, each experiment may either done by each student individually or in group of not more than 3-4 students. Larger groups be strictly discouraged/disallowed.

Lab Outcomes: At the end of this lab students will demonstrate the ability to

1. Understand the concepts of control systems and importance of feedback in control systems.
2. Perform signal flow graph and formulate transfer function.
3. Perform computations and solve problems on frequency response analysis.
4. Analyse Polar, Bode and Nyquist's plot.
5. Evaluate different types of state models and time functions.
6. Analyse different types of control systems like linear and non-linear control systems, etc.

MICROPROCESSORS AND MICROCONTROLLERS LABORATORY

Course Code					
Category	**Laboratory Courses**				
Course title	**Microprocessors and Microcontrollers Laboratory**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VI**
	0	**0**	**2**	**1**	
Class Work	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Notes:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus.

(iii) Group of students for practical should be 15 to 20 in number.

List of Experiments:

1. Write a program using 8085 and verify for:
   a) Addition of two 8-bit numbers.
   b) Addition of two 8-bit numbers (with carry).
2. Write a program using 8085 and verify for:
   a) 8-bit subtraction (display borrow)
   b) 16-bit subtraction (display borrow)
3. Write a program using 8085 for multiplication of two 8- bit numbers by repeated addition method. Check for minimum number of additions and test for typical data.
4. Write a program using 8085 for multiplication of two 8- bit numbers by bit rotation method and verify.
5. Write a program using 8086 for finding the square root of a given number and verify.
6. Write a program using 8086 for copying 12 bytes of data from source to destination and verify.
7. Write a program using 8086 and verify for:
   a) Finding the largest number from an array.
   b) Finding the smallest number from an array.
8. Write a program using 8086 for arranging an array of numbers in descending order and verify.
9. Write a program using 8086 for arranging an array of numbers in ascending order and verify.
10. Write a program to interface a two-digit number using seven-segment LEDs. Use 8085/8086 microprocessor and 8255 PPI.
11. Write a program to control the operation of stepper motor using 8085/8086 microprocessor and 8255 PPI.
12. To study implementation and interfacing of Display devices Like LCD, LED Bar graph and seven segment display with Microcontroller 8051/AT89C51
13. To study implementation and interfacing of Different motors like stepper motor, DC motor and servo Motors.
14. Write an ALP for temperature and pressure measurement
15. Write a program to interface a graphical LCD with 89C51

Note:

1. Each laboratory group shall not be more than about 20 students.
2. To allow fair opportunity of practical hands-on experience to each student, each experiment may either done by each student individually or in group of not more than 3-4 students. Larger groups be strictly discouraged/disallowed.

Lab Outcomes:

At the end of this lab students will be able to:

1. Understand the fundamentals of Microprocessors.
2. Understand the internal design of 8051 microcontroller along with the features and their programming.
3. Competent with the on-chip peripherals of microcontrollers.
4. Design different interfacing applications using microcontrollers and peripherals.
5. Demonstrate the limitations and strengths of different types of microcontrollers and their comparison.
6. Build systems using microcontrollers for real time applications.

PROJECT-I

Course Code					
Category	**Project**				
Course title	**Project-I**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VI**
	0	**0**	**4**	**2**	
Class Work	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Course objectives:

1. To allow students to demonstrate skills learned during their course of study by asking them to deliver a product that has passed through the design, analysis, testing and evaluation
2. To encourage research through the integration learned in a number of courses.
3. To allow students to develop problem solving skills.
4. To encourage teamwork.
5. To improve students' communication skills by asking them to produce both a professional report and to give an oral presentation and prepare a technical report.

The students are required to undertake institutional project work.

The final Viva voice of the institutional project work will be conducted by an external examiner and one external examiner appointed by the institute. External examiner will be from the panel of examiners submitted by the concerned institute approved by the board of studies in engineering and technology. Assessment of institutional project work will be based on seminar, viva-voice and report of institutional project work obtained by the student from the industry or institute.

The internal marks distribution for the students consists of 50 marks internally and 50 marks by an external examiner.

Course outcomes

On successful completion of the course students will be able to:

1. Demonstrate a sound technical knowledge of their selected project topic.
2. Undertake problem identification and formulation.
3. Design engineering formula to complex problems utilising a systems approach.
4. Research and engineering project.
5. Communicate with engineers and the community at large in written and oral form.
6. Demonstrate the knowledge, skills and attitudes of a professional engineer.

ECONOMICS FOR ENGINEERS

Course Code					
Category	**Non-Credit**				
Course title	**Economics for Engineers**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VI**
	2	**0**	**0**	**0**	
Class Work	30				
Exam	70				
Total	100				
Duration of Exam	3 Hrs				

Note: The examination of the regular students will be conducted by the concerned college/Institute internally. Each student will be required to score a minimum of 40% marks to qualify in the paper. The marks will not be included in determining the percentage of marks obtained for the award of a degree.

Course Objectives:

1. Acquaint the students to basic concepts of economics and their operational significance.
2. Acquaint students with market and its operation.
3. To stimulate the students to think systematically and objectively about contemporary economic problems.

Unit-I

Definition of Economics- Various definitions, types of economics- Micro and Macro Economics, nature of economic problem, Production Possibility Curve, Economic laws and their nature, Relationship between Science, Engineering, Technology and Economic Development.

Demand- Meaning of Demand, Law of Demand, Elasticity of Demand- meaning, factors effecting it, its practical application and importance.

Unit-II

Production- Meaning of Production and factors of production, Law of variable proportions, Returns to scale, Internal and external economies and diseconomies of scale.

Various concepts of cost of production- Fixed cost, Variable cost, Money cost, Real cost, accounting cost, Marginal cost, Opportunity cost. Shape of Average cost, Marginal cost, Total cost etc. in short run and long run.

Unit-III

Market- Meaning of Market, Types of Market- Perfect Competition, Monopoly, Monopolistic Competition and Oligopoly (main features).

Supply- Supply and law of supply, Role of demand and supply in price determination and effect of changes in demand and supply on prices.

Unit-IV

Indian Economy- Nature and characteristics of Indian economy as under developed, developing and mixed economy (brief and elementary introduction), Privatization - meaning, merits and demerits. Globalization of Indian economy - merits and demerits. Banking- Concept of a Bank, Commercial Bank- functions, Central Bank- functions, Difference between Commercial and Central Bank.

Course outcomes:

1. The students will able to understand the basic concept of economics.
2. The students will able to understand the basic concept of demand.
3. The student will able to understand the concept of production and cost.
4. The student will able to understand the concept of market.
5. The students will able to understand the basic concept of supply.
6. The student will able to understand the concept of privatization, globalization and banks.

References:

1. Jain T.R., Economics for Engineers, VK Publication.
2. Chopra P. N., Principle of Economics, Kalyani Publishers.
3. Dewett K. K., Modern economic theory, S. Chand.
4. H. L. Ahuja., Modern economic theory, S. Chand.

5. Dutt Rudar & Sundhram K. P. M., Indian Economy.
6. Mishra S. K., Modern Micro Economics, Pragati Publications.
7. Singh Jaswinder, Managerial Economics, dreamtech press.
8. A Text Book of Economic Theory Stonier and Hague (Longman's Landon).
9. Micro Economic Theory – M.L. Jhingan (S.Chand).
10. Micro Economic Theory - H.L. Ahuja (S.Chand).
11. Modern Micro Economics: S.K. Mishra (Pragati Publications).

Gurugram University Scheme of Studies and Examination

Bachelor of Technology Semester 7

S.No.	Category	Course Code	Course Title	Hours per week			Credits	Marks for Sessional	Marks for End Term Examination	Total
				L	T	P				
1	PCC		Renewable Energy and Distributed Generation	3	0	0	3	30	70	100
2	HSMC		Organizational Behaviour	3	0	0	3	30	70	100
3	PEC		Professional Elective-IV	3	0	0	3	30	70	100
4	OEC		Open Elective-III	3	0	0	3	30	70	100
5	OEC		Open Elective-IV	3	0	0	3	30	70	100
6	PT		Practical Training-II	0	0	2	2	100	-	100
7	PROJ		Project-II	0	0	8	4	100	100	200
8	LC		Renewable Energy and Distributed Generation Lab	0	0	2	1	50	50	100
Total							**22**			**900**

NOTE:

1. Choose any one from Professional Elective Course-IV
2. Choose any one from each of the Open Elective Course-III and IV

PROFESSIONAL ELECTIVE- IV (Semester-VII)

Sr. No	Code	Subject	Credit
1.		High Voltage Engineering	3
2.		Intelligent Instrumentation	3
3.		Solar Technology Appliances and Application	3
4.		Advanced Power Electronics	3
5.		Renewable Energy Converters	3

RENEWABLE ENERGY AND DISTRIBUTED GENERATION

Course Code					
Category	**Professional Core Courses**				
Course title	**Renewable Energy and Distributed Generation**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VII**
	3	**0**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

1. To learn various renewable energy sources
2. To gain understanding of integrated operation of renewable energy sources.
3. To understand Power Electronics Interface with the Grid.
4. To understand control and operation of MICROGRID.

Unit-I

Introduction: Introduction of Distributed vs Central Station Generation, Sources of Energy such as Microturbines, Internal Combustion Engines. Introduction to Solar Energy, Wind Energy, Combined Heat and Power, Hydro Energy, Tidal Energy, Wave Energy, Geothermal Energy, Biomass and Fuel Cells.

Unit-II

Power Electronic Interface with the Grid, Impact of Distributed Generation on the Power System, Power Quality Disturbances, Transmission System Operation, Protection of Distributed Generators, Economics of Distributed Generation

Unit-III

IMPACT OF GRID INTEGRATION: Requirements for grid interconnection, limits on operational parameters, voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with NCE sources on existing power system: reliability, stability and power quality issues.

BASICS OF A MICROGRID: Concept and definition of microgrid, microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrid, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids,

Unit-IV

CONTROL AND OPERATION OF MICROGRID: Modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication-based techniques, microgrid communication infrastructure, Power quality issues in microgrids, regulatory standards, Microgrid economics, Introduction to smart microgrids.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand about renewable energy.
2. Understand power electronic interface with the grid.
3. Understand the working of distributed generation system in autonomous/grid connected modes.
4. Know the Impact of Distributed Generation on Power System.
5. Understand basics of a microgrid.
6. Analyze control and operation of microgrid.

Text / References

1. Ranjan Rakesh, Kothari D.P, Singal K.C, "Renewable Energy Sources and Emerging Technologies",2nd Ed. Prentice Hall of India ,2011
2. Math H. Bollen, Fainan Hassan, "Integration of Distributed Generation in the Power System", July2011, Wiley–IEEE Press
3. Loi Lei Lai, Tze Fun Chan, "Distributed Generation: Induction and Permanent Magnet Generators", October 2007, Wiley-IEEE Press.

4. Roger A. Messenger, Jerry Ventre, “Photovoltaic System Engineering”, 3rd Ed, 2010
5. James F. Manwell, Jon G. McGowan, Anthony L Rogers, “Wind energy explained: Theory Design and Application”, John Wiley and Sons 2nd Ed, 2010

ORGANIZATIONAL BEHAVIOR

Course Code					
Category	**Humanities and Management course**				
Course title	**Organizational Behavior**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VII**
	3	**0**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

1. The objective of Organizational Behavior (OB) is to study human behavior within an organizational context.
2. The objective of Organizational Behavior (OB) is to understand human behavior within an organizational context.
3. The course aims to provide students with knowledge and skills to analyze and explain individual and group behavior in organizations.
4. The course aims to provide students with knowledge and skills to influence individual and group behavior in organizations.

Unit-I

Introduction of Management: Meaning, definitions, nature of management; Managerial levels, skills and roles in an organization; Functions of Management: Planning, Organizing, staffing, Directing and Controlling, Interrelationship of managerial functions, scope of management and Importance of management. Difference between management and administration.

Unit-II

Introduction of organization: Meaning and process of Organization, Management v/s organization; Fundamentals of Organizational Behavior: Concepts, evolution, importance and relationship with other Fields; Contemporary challenges and opportunities of OB. Individual Processes and Behavior, Personality, Concept, determinants and applications; Perception, Concept, process and applications, Learning, Concept (Brief Introduction); Motivation, Concept, techniques and importance

Unit-III

Interpersonal Processes, Teams and Groups, Definition of Group, Stages of group development, Types of groups, meaning of team, merits and demerits of team; difference between team and group, Conflict, Concept, sources, types, management of conflict; Leadership: Concept, function, styles and qualities of leadership. Communication – Meaning, process, channels of communication, importance and barriers of communication.

Unit-IV

Organizational Processes: Organizational structure, Meaning and types of organizational structure and their effect on human behavior; Organizational culture, Elements, types and factors affecting organizational culture. Organizational change: Concept, types and factors affecting organizational change, Resistance to Change.

Course Outcomes:

At the end of this course,

1. Students will be able to apply the managerial concepts in practical life.
2. Students will be able to understand the functions of management.
3. The students will be able to understand the concept of organizational behavior at individual level and interpersonal level.
4. Students will be able to understand the behavioural dynamics in organizations.
5. Students will be able to understand the leadership.
6. Students will be able to understand the organizational culture and change

Text / References

1. Robbins, S.P. and Decenzo, D.A. Fundamentals of Management, Pearson Education Asia, New Delhi.
2. Stoner, J et. al, Management, New Delhi, PHI, New Delhi.
3. Satya Raju, Management – Text & Cases, PHI, New Delhi.
4. Kavita Singh, Organisational Behaviour: Text and cases. New Delhi: Pearson Education.

5. Pareek, Udai, Understanding Organisational Behaviour, Oxford University Press, New Delhi.
6. Robbins, S.P. & Judge, T.A., Organisational Behaviour, Prentice Hall of India, New Delhi.
7. Ghuman Karminder, Aswathappa K., Management concept practice and cases, Mc Graw Hill education.
8. Chhabra T. N., Fundamental of Management, Sun India Publications, New Delhi

HIGH VOLTAGE ENGINEERING

Course Code					
Category	**Professional Elective Courses**				
Course title	**High Voltage Engineering**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VII**
	3	**0**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

1. To learn Physics behind conduction and breakdown
2. To gain understanding of High voltage generation and measurement.
3. To understand Overvoltage Phenomenon and Insulation Coordination in Electric Power Systems.
4. To understand testing of high voltage equipment.

Unit-I

Conduction and Breakdown in Gases:
Collision Process, Ionization Processes, Townsend's Current Growth Equation, Current Growth in the Presence of Secondary Processes, Townsend's Criterion for Breakdown, Experimental Determination of Coefficients α and γ, Breakdown in Electronegative Gases, Time Lags for Breakdown, Streamer Theory of Breakdown in Gases, Paschen's Law, Breakdown in Non-Uniform Fields and Corona Discharges.
Conduction and Breakdown in Liquid Dielectrics:
Liquids as Insulators, Pure Liquids and Commercial Liquids, Conduction and Breakdown in Pure Liquids, Conduction and Breakdown in Commercial Liquids.
Breakdown in Solid Dielectrics:
Introduction, Intrinsic Breakdown, Electromechanical Breakdown, Thermal Breakdown.

Unit-II

Generation of High Voltages and Currents:
Generation of High Direct Current Voltages, Generation of High Alternating Voltages, Generation of Impulse Voltages, Generation of Impulse Currents, Tripping and Control of Impulse Generators.
Measurement of High Voltages and Currents:
Measurement of High Direct Current Voltages, Measurement of High AC and Impulse Voltages, Measurement of High Currents – Direct, Alternating and Impulse, Cathode Ray Oscillographs for Impulse Voltage and Current Measurements.

Unit-III

Overvoltage Phenomenon and Insulation Coordination in Electric Power Systems:
National Causes for Overvoltages - Lightning Phenomenon, Overvoltage due to Switching Surges, System Faults and Other Abnormal, Principles of Insulation Coordination on High Voltage and Extra High Voltage Power Systems.
Non-Destructive Testing of Materials and Electrical Apparatus:
Introduction, Measurement of Dielectric Constant and Loss Factor, Partial Discharge Measurements.

Unit-IV

HV Testing of Electrical Apparatus:
Testing of Insulators and Bushings, Testing of Isolators and Circuit Breakers, Testing of Cables, Testing of Transformers, Testing of Surge Arrestors, Radio Interference Measurements, Testing of HVDC Valves and Equipment.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Explain conduction and breakdown phenomenon in gases, liquid dielectrics.
2. Analyze breakdown phenomenon in solid dielectrics.
3. Explain generation of high voltages and currents

4. Analyze measurement techniques for high voltages and currents.
5. Discuss overvoltage phenomenon and insulation coordination in electric power systems.
6. Perform non-destructive testing of materials and electric apparatus and high-voltage testing of electric apparatus.

Text / References

1. High Voltage Engineering M.S. Naidu, V. Kamaraju McGraw Hill 5 th Edition, 2013.
2. High Voltage Engineering Fundamentals E. Kuffel, W.S. Zaengl, J. Kuffel Newnes 2nd Edition, 2000
3. High Voltage Engineering Wadhwa C.L. New Age International 3rd Edition, 2012
4. High-Voltage Test and Measuring Techniques Wolfgang Hauschild • Eberhard Lemke Springer 1st Edition 2014
5. High Voltage Engineering Farouk A.M. Rizk CRC Press 1st Edition2014

INTELLIGENT INSTRUMENTATION

Course Code					
Category	**Professional Elective Courses**				
Course title	**Intelligent Instrumentation**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VII**
	3	**0**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

1. To learn various Intelligent instrumentation.
2. To gain understanding of Data acquisition system and signal processing.
3. To understand Intelligence sensor device for measurement and instrumentation.
4. To understand Interfacing instruments and computers.

Unit-I

Intelligence, features characterizing intelligence, intelligent instrumentation system: features of intelligent instrumentation, components of intelligent instrumentation, block diagram of intelligent instrumentation.

Unit-II

Signal amplification and attenuation (OP-AMP based), instrumentation amplifier (circuit diagram, high CMRR & other features), signal linearization (different types such as diode resistor combination, OPAMP based etc.), bias removal signal filtering (output from ideal filters, output from constant – k filters, matching of filter sections, active analog filters).

Unit-III

OP-AMP based voltage to current converter, current to voltage conversion, signal integration, voltage follower (pre amplifier), voltage comparator, phase locked loop, signal addition, signal multiplication, signal transmission, description of spike filter.
Smart sensors: Primary sensors, excitation, compensation, information coding/processing, data compensation, standard for smart sensor interface.

Unit-IV

Interfacing instruments and computers: basic issues of interfacing, address decoding, data transfer control, A/D convertor, D/A convertors, sample and hold circuit, other interface considerations.

Course Outcomes:

At the end of this course, students will be able to

1. Understand the basic characteristic of intelligent instrumentation system Knowledge of new sensor technology
2. Understand the data acquisition system in intelligent instrumentation system
3. Understand the Signal amplification and attenuation.
4. Develop the design methodologies for measurement and instrumentation of real-world problems.
5. Study the concepts of intelligent sensor devices, their performance characteristics and signal and system dynamics.
6. Understand Interfacing instruments and computers.

Text / References

1. Principles of measurements and instrumentation by Alan S Morris, PHI
2. Intelligent instrumentation by Bamay, G.C.Prentice Hall
3. Sensors and transducers by Parranabis, PHI
4. Introduction to digital signal processing: MGH

SOLAR TECHNOLOGY APPLIANCES AND APPLICATION

Course Code						
Category	**Professional Elective Courses**					
Course title	**Solar Technology Appliances and Application**					
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VII**	
	3	**0**	**0**	**3**		
Class Work	30 Marks					
Exam	70 Marks					
Total	100 Marks					
Duration of Exam	3Hrs					

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

1. To learn the fundamental concepts about solar energy systems and devices
2. To study the performance of each system in detail along with practical case studies
3. To learn the fundamental concepts about solar energy systems and devices
4. To study the performance of each system in detail along with practical case studies

Unit-I

Solar Radiation: Solar Radiation Outside the Earth's Atmosphere, Solar Radiation at the Earth's Surface, Instruments for Measuring Solar Radiation and Sunshine, Solar Radiation Data, Solar Radiation Geometry, Empirical Equations for Predicting the Availability of Solar Radiation, Solar Radiation on Tilted Surfaces. Heat transfer concept.

Solar Energy Collectors: Liquid Flat-Plate Collectors**,** Concentrating Collectors, Flat-plate Collectors with Plane Reflectors, Cylindrical Parabolic Collector, Compound Parabolic Collector (CPC), Paraboloid Dish Collector, Central Receiver Collector,

Unit-II

Thermal Energy Storage: Introduction, Sensible Heat Storage, Latent Heat Storage, Thermochemical Storage

Solar Air Heaters and greenhouse drying system: Introduction, Performance Analysis of a Conventional Air Heater, Other Types of Air Heaters, Greenhouse effect, solar drying, types of dryers, drying mechanics.

Unit-III

SOLAR LIGHTING: Solar cell – Working principle of a solar cell – Solar home lighting systems – Solar Street lighting systems - Solar lanterns – Applications - Rural electrification process – Case studies.

SOLAR COOKING: Introduction – Types of solar cookers – Advantages and disadvantages - Box type – Parabolic dish cooker - Performance evaluation of solar cookers – Testing of a solar cooker – Applications of solar cooking - Case studies

Unit-IV

SOLAR DRYING Introduction – Need for solar drying - Basics of solar drying – Types of solar dryers – Direct type solar dryer – Mixed mode type solar dryer – Forced circulation type dryers – Hybrid dryer – Bin type dryer – Solar timber drying – Applications - Case studies.

SOLAR DESALINATION: Introduction – Necessity for desalination – Study on various desalination techniques – Comparison between conventional and solar desalination – Basics of solar still - Simple solar still – Material problems in solar still – Solar disinfection and its methods – Case studies on various desalination techniques.

Course Outcomes:

At the end of this course, students will demonstrate the ability to understand

1. The fundamental concepts about solar energy systems and devices are incorporated.
2. The performance of the systems along with practical case studies were done.
3. The fundamental concepts about thermal energy systems and devices are incorporated.
4. The performance of the systems along with practical case studies were done.
5. The fundamental concepts about solar drying and desalination systems and devices are incorporated.
6. The performance of the systems along with practical case studies were done.

Text / References

1. Solar Energy by S.P. Sukhatme

2. Solar Thermal Engineering by P.J. Lunde
3. Solar Energy by J.S. Hsieh
4. Solar Thermal Engineering Systems by G.N. Tiwari and S. Suneja
5. Solar energy by G.N. Tiwari, Alpha Science, 2002
6. Suhatme and Nayak, Solar Energy: Principles of Thermal Collection and Storage, Tata McGraw Hill, 2008.
7. HP Garg and J Prakash: Solar Energy: Fundamentals and Applications, Tata McGraw Hill, 2010.
8. Rai, G.D., Solar Energy Utilization, KhannaPublishers,Delhi, 2010.
9. Michael Grupp, Time to Shine: Applications of Solar Energy Technology, John Wiley & Sons, 2012.
10. SM Sze, Kwok K Ng: Physics of semiconductor devices, third edition, John Wiley & Sons, 2007. 6. Daniel J. O'Connor, 101 patented solar energy uses,VanNostrand Reinhold Co., 2007.
11. Martin A. Green, Solar Cells Operating Principles, Technology, and System Applications Prentice- Hall, 2008

ADVANCED POWER ELECTRONICS

Course Code					
Category	**Professional Elective Courses**				
Course title	**Advanced Power Electronics**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VII**
	3	**0**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

1. To review basic concepts of power electronics in the field of power control and drives.
2. To address the underlying concepts and methods behind Advanced Power Electronics.
3. To impart knowledge of power semiconductor technologies.
4. To impart knowledge of power electronics advancement in the field of power conversion.

Unit-I

Advanced solid-state devices such as MOSFETs, IGBT, GTO, IGCT etc, their power modules, intelligent power modules, thermal design, protection, gating circuits, digital signal processors used in their control. Non isolated and isolated dc- dc converters such as buck, boost, buck-boost, flyback, forward, Cuk, SEPIC, Zeta, half bridge, push-pull and bridge in DCM and CCM, single-phase, single-stage converters (SSSSC), power factor correction at ac mains in these converters, their application in SMPS, UPS, welding and lighting systems.

Unit-II

Improved power quality ac-dc converters such as single-phase buck, boost, buck-boost ac- dc converters, PWM (Pulse width modulated) based single phase, three-phase VSC (Voltage source converters), multilevel VSCs, multipulse VSCs, PWM CSC (Current voltage source converters), multipulse ac-dc converters. power quality mitigation devices such as passive filters, active filters, hybrid filters, DTSTCOM (Distribution static compensator), DVR (Dynamic voltage restorers) and UPQC (Universal power quality conditioners).

Unit-III

FACTS devices such TCR (thyristor-controlled reactor), TSC (thyristor switched capacitors), STATCOM (Static synchronous compensator), SSSC (Static series synchronous compensator), UPFC (Unified power flow controller), IPFC (Interline power flow controller). HVDC (High voltage direct current) system such as 12-pulse converter based HVDC systems, HVDC light, HVDC PLUS (Power universal link), multipulse and multilevel VSC based flexible HVDC systems.

Unit-IV

Solid state controllers for motor drives such as vector control and direct torque control of induction motor, synchronous motor, permanent magnet sine fed motor, synchronous reluctance motor, permanent magnet brushless dc (PMLDC) motor, LCI (load commutated inverter) fed large rating synchronous motor drives, energy conservation and power quality improvement in these drives.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Theoretical and practical knowledge on modern day semiconductor devices, their characteristics and control.
2. Understand improved power quality by converters.
3. Understanding operation and analysis of switched mode DCDC converters and their designing.
4. Understand FACTS devices.
5. Knowledge of power conditioners and their application.
6. Working knowledge of static applications of advanced power electronics like UPS, HVDC, Automotive etc.

Text / References

1. R. S. Ramshaw, “Power Electronics Semiconductor Switches”, Champman & Hall, 1993.
2. N. Mohan, T. M. Undeland and W. P. Robbins, “Power Electronics, Converter, Application and Design”, Third Edition, John

Willey & Sons, 2004.
3. M. H. Rashid, “Power Electronics, circuits, Devices and Applications”, Pearson, 2002, India.
4. K. Billings, “Switch Mode Power Supply Handbook”, McGraw-Hill, 1999, Boston.
5. A. I. Pressman, “Switch Mode Power Supply Design”, McGraw-Hill, 1999, New York.
6. N. G. Hingorani and L. Gyugyi, “Understanding FACTS”, IEEE Press, Delhi, 2001.
7. B. K. Bose, “Power Electronics and Variable Frequency Drive”, Standard Publishers Distributors, 2000.
8. Bin Wu, “High-Power Converters and AC Drives”, IEEE Press, A John Wiley & Sons, Inc Publication, New York,2006.
9. G. T. Heydt, “Electric Power Quality”, Stars in a Circle Publications, second edition, 1994, Avarua, Rarotonga, Cook Islands.
10. R. C. Duagan, M. F. Mcgranaghan and H. W. Beaty, “Electric Power System Quality”, McGraw-Hill, 2001, 1221 Avenue of the Americas, New York.
11. Vijay K. Sood, “HVDC and FACTS Controllers -Applications of Static Converters in Power Systems”, Kluwer Academic Publishers, Massachusetts, 2004.

RENEWABLE ENERGY CONVERTERS

Course Code					
Category	**Professional Elective Courses**				
Course title	**Renewable Energy Converters**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VII**
	3	**0**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

1. To understand about various advanced power converters.
2. To analyze and design different power converter circuits used in renewable energy systems.
3. To analyze power converters for buck boost operation.
4. To analyze power converters for grid converter operation.

Unit-I

Introduction Review of 2-pulse and 6-pulse converters and their performance with inductive and capacitive loads. Harmonic analysis of single-phase and three-phase converters.

Unit-II

Power Converters for Solar PV Systems, Multi-level converters, topologies and control techniques, PWM techniques.

Unit-III

Power Converters for Fuel Cells Buck converter, Boost converter, Interleaved buck/boost converter, advanced modulation techniques

Unit-IV

Power Converters in WECS Multi-channel interleaved boost converters, voltage source converters, control of grid-tied converters, matrix converter, and modular multi-level inverters.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand advanced concepts in power electronics.
2. Understand about various advanced power converters
3. Adaptability to analyze power converter based renewable energy systems.
4. Analyze power converters for buck boost operation.
5. Analyze power converters for grid converter operation.
6. To troubleshoot gird compatibility issues with power electronics circuits.

Text / References

1. V. Yaramasu and B.Wu, "Model Predictive Control of Wind Energy Conversion Systems," Wiley- IEEE Press, 2016.
2. Rashid M. H., “Power Electronics Circuits Devices and Applications”, 3rd Ed., Pearson Education, 2008.
3. Lander Cyril W., “Power Electronics”, Prentice Hall of India Private Limited, 2004.
4. Mohan N., Undeland T.M. and Robbins W.P., “Power Electronics-Converters, Applications and Design”, 3rd Ed.,Wiley India, 2008.
5. Paice D. A., “Power Electronic Converter Harmonics – Multipulse Methods for Clean Power”, IEEE press, 1995.

PRACTICAL TRAINING-II

Course Code					
Category	**PT**				
Course title	**Practical Training-II**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VII**
	0	**0**	**2**	**2**	
Class Work	100 Marks				
Exam					
Total	100 Marks				
Duration of Exam					

The students are required to undergo practical training of duration not less than 1.5 months in a reputed organization or concerned institute. The students who wish to undergo practical training, the industry chosen for undergoing the training should be at least a private limited company. The students shall submit and present the midterm progress report at the institute. the presentation will be attended by a committee. alternately the teacher may visit the industry to get the feedback of the student.

The final Viva voice of the practical training will be conducted by an external examiner and one external examiner appointed by the institute. External examiner will be from the panel of examiners submitted by the concerned institute approved by the board of studies in engineering and technology. Assessment of industrial training will be based on seminar, viva-voice, report and certificate of practical training or institutional project work obtained by the student from the industry or institute.

The internal marks distribution for the students who have undergone industrial training consist of 100 marks internally.

PROJECT-II

Course Code					
Category	**Project**				
Course title	**Project-II**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VII**
	0	**0**	**8**	**4**	
Class Work	100 Marks				
Exam	100 Marks				
Total	200 Marks				
Duration of Exam	3Hrs				

Course objectives:

1. To allow students to demonstrate a wide range of the skills by working on PROJECT-I that has passed through the design, analysis, testing and evaluation
2. To encourage problem solving skills.
3. To allow students to develop problem solving, synthesis and evaluation skills.
4. To encourage teamwork and leadership.
5. To improve students' communication skills by asking them to produce both a professional report and a professional poster and to give an oral presentation.

The students are required to undertake institutional project work.

The final Viva voice of the institutional project work will be conducted by an external examiner and one external examiner appointed by the institute. External examiner will be from the panel of examiners submitted by the concerned institute approved by the board of studies in engineering and technology. Assessment of institutional project work will be based on seminar, viva-voice and report of institutional project work obtained by the student from the industry or institute.

The internal marks distribution for the students consists of 100 marks internally and 100 marks by an external examiner.

Course outcomes

On successful completion of the course students will be able to:

1. Demonstrate a sound technical knowledge of their selected project solution.
2. Undertake problem solution.

3. Design engineering solutions to complex problems utilising a systems approach.
4. Conduct the remaining engineering project.
5. Communicate with team members at large in written an oral form.
6. Demonstrate the knowledge, skills and attitudes of a professional engineer.

RENEWABLE ENERGY AND DISTRIBUTED GENERATION LAB

Course Code						
Category	**Laboratory Courses**					
Course title	**Renewable Energy and Distributed Generation Lab**					
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VII**	
	0	**0**	**2**	**1**		
Class Work	50 Marks					
Exam	50 Marks					
Total	100 Marks					
Duration of Exam	3Hrs					

Notes:

(iii) At least 10 experiments are to be performed by students in the semester.

(iv) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus

LIST OF EXPERIMENTS

1. Introduction to MATLAB or any other software.
2. Modelling of PV cell
3. Effect Of Temperature Variation on Photovoltaic Array
4. Effect of irradiation on a photovoltaic array
5. Design of solar PV boost converter using PandO MPPT technique.
6. Open circuit voltage of PV cells and short circuit current of PV cells
7. Explore Wind Turbines
8. Effect of Load on Wind Turbine Output
9. Draw Power Curves and energy
10. Build a Wind Farm
11. Designing and planning of a stand-alone system

Note:

1. Each laboratory group shall not be more than about 20 students.
2. To allow fair opportunity of practical hands-on experience to each student, each experiment may either done by each student individually or in group of not more than 3-4 students. Larger groups be strictly discouraged/disallowed.

Lab Outcomes:

At the end of this lab, students will demonstrate the ability to

1. Understand about renewable energy.
2. Understand power electronic interface with the grid.
3. Understand the working of distributed generation system in autonomous/grid connected modes.
4. Know the Impact of Distributed Generation on Power System.
5. Understand basics of a microgrid.
6. Analyze control and operation of microgrid.

Gurugram University Scheme of Studies and Examination

Bachelor of Technology Semester 8

S.No.	Category	Course Code	Course Title	Hours per week			Credits	Marks for Sessional	Marks for End Term Examination	Total
				L	T	P				
1	ESC		MOOC-1 (Essential)	3	0	0	3	25	75	100
2	ESC		MOOC-2 (Essential)	3	0	0	3	25	75	100
3	PROJ		Industrial Project / Project-III	0	0	16	8	150	150	300
Total							**14**			**500**

MOOC-1 (ESSENTIAL)

Course Code					
Category	**Engineering Science Course**				
Course title	**MOOC-1 (Essential)**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VIII**
	3	**0**	**0**	**3**	
Class Work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

A student has to complete NPTEL/SWAYAM Courses of 12 Weeks respectively through MOOCs. For registration to MOOCs Courses, the students shall follow NPTEL/SWAYAM Site http://nptel.ac.in/ as per the NPTEL policy and norms. The students can register for these courses through NPTEL/SWAYAM directly as per the course offering in Odd/Even Semesters at NPTEL/SWAYAM. These NPTEL/SWAYAM courses (recommended by the University) may be cleared during the B. Tech degree program (not necessary one course in each semester). After successful completion of these MOOCS courses the students, shall, provide their successful completion NPTEL/SWAYAM status/certificates to the University (COE) through their college of study only.

MOOC-2 (ESSENTIAL)

Course Code					
Category	**Engineering Science Course**				
Course title	**MOOC-2 (Essential)**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VIII**
	3	**0**	**0**	**3**	
Class Work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

A student has to complete NPTEL/SWAYAM Courses of 12 Weeks respectively through MOOCs. For registration to MOOCs Courses, the students shall follow NPTEL/SWAYAM Site http://nptel.ac.in/ as per the NPTEL policy and norms. The students can register for these courses through NPTEL/SWAYAM directly as per the course offering in Odd/Even Semesters at NPTEL/SWAYAM. These NPTEL/SWAYAM courses (recommended by the University) may be cleared during the B. Tech degree program (not necessary one course in each semester). After successful completion of these MOOCS courses the students, shall, provide their successful completion NPTEL/SWAYAM status/certificates to the University (COE) through their college of study only.

INDUSTRIAL PROJECT/PROJECT-III

Course Code					
Category	**Project**				
Course title	**Industrial Project/Project-III**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VIII**
	0	**0**	**16**	**8**	
Class Work	150 Marks				
Exam	150 Marks				
Total	300 Marks				
Duration of Exam	3Hrs				

Course objectives:

1. To allow students to demonstrate a wide range of the skills learned during their course of study by asking them to deliver a product that has passed through the design, analysis, testing and evaluation
2. To encourage multidisciplinary research through the integration learned in a number of courses.
3. To allow students to develop problem solving, analysis, synthesis and evaluation skills.
4. To encourage teamwork.
5. To improve students' communication skills by asking them to produce both a professional report and a professional poster and to give an oral presentation

The students are required to undergo industrial training or institutional project work of duration not less than 4 months in a reputed organization or concerned institute. The students who wish to undergo industrial training, the industry chosen for undergoing the training should be at least a private limited company. The students shall submit and present the midterm progress report at the institute. the presentation will be attended by a committee. alternately the teacher may visit the industry to get the feedback of the student.

The final Viva voice of the industrial training or institutional project work will be conducted by an external examiner and one external examiner appointed by the institute. External examiner will be from the panel of examiners submitted by the concerned institute approved by the board of studies in engineering and technology. Assessment of industrial training or institutional project work will be based on seminar, yiva-voice, report and certificate of industrial training or institutional project work obtained by the student from the industry or institute.

The internal marks distribution for the students who have undergone industrial training consist of 150 marks internally and 150 marks buy an external examiner.

Course outcomes

On successful completion of the course students will be able to:

1. Demonstrate a sound technical knowledge of their selected project topic.
2. Undertake problem identification, formulation and solution.
3. Design engineering solutions to complex problems utilising a systems approach.
4. Conduct an engineering project.
5. Communicate with engineers and the community at large in written an oral form.
6. Demonstrate the knowledge, skills and attitudes of a professional engineer.