PROGRAMME CURRICULUM

AND

SYLLABI OF

DIPLOMA PROGRAMME IN

ELECTRICAL ENGINEERING

UNDER RATIONALISED SEMESTER SYSTEM

(IMPLEMENTED FROM ACADEMIC YEAR 2020-2021)

BOARD OF TECHNICAL EDUCATION, GOA STATE

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SYLLABUS STRUCTURE FOR ELECTRICAL ENGINEERING

DIPLOMA IN ELECTRICAL ENGINEERING

(GC101) Communication Skills

1. COURSE OBJECTIVE :

The course aims to develop Communication skills in English by improving students' ability to write ,speak, listen and read effectively. Emphasis is also laid on students' personality development, helping them to build their confidence in interpersonal / group communication.

2. TEACHING AND EXAMINATION SCHEME

Semester	**I**								
Course code & course title		**Periods/Week (in hours)**			**Total Hours**	**Examination Scheme**			
						Theory Marks		**Practical Marks**		**Total Marks**
(GC101) Communication Skills		**L**	**T**	**P**	**H**	**TH**	**TM**	**TW**	**PR/OR**	
		-	**-**	**02**	**32**	**-**	**-**	**25**	**25**	**50**

3 . COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

GC101.CO1 Understand the essentials of effective Communication.

GC101CO2 Develop reading. writing, speaking , listening and effective presentation skills.

GC101.CO3 Select the appropriate mode of Communication .

GC101.CO4 Demonstrate reading. writing, speaking , listening and effective presentation skills.

4.Mapping Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO1	0	0	0	0	3	3	3
CO2	1	0	1	0	3	3	3
CO3	1	0	1	0	3	3	3
CO4	1	0	0	0	3	3	3

Relationship : Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	**Phr = Practical hours**	**CO = Course Outcomes**		

Unit	**M**	**Phr**	**CO**
1 UNIT NAME: FUNDAMENTALS OF COMMUNICATION SKILLS	**-**		**CO1 CO2 CO3 CO4**
1.1 **Communication Skills fundamentals** Definition, communication process, importance of Communication Skills, essentials of effective communication		01	
1.2 **Types of communication**: verbal Communication and Nonverbal communication (Body language, facial expressions, gestures, eye contact, posture, dress and grooming/personal appearance, deportment, personal hygiene) Paralinguistic (Volume, pace, pitch, pauses)		02	
1.3 **Barriers to communication:** physical barriers, psychological barriers and cultural barriers		01	
2. Unit: PRESENTATION SKILLS			
2.1 Presentations: Methods and style of presentation, Importance, planning a presentation, venue selection, audience awareness (age, gender, profession background, educational and social background) time and duration, audio visual aids (OHP, LCD projector, flip charts, white/black/green board, computer, microphone)		**02**	**CO2 CO3 CO4**
2.2 Public speaking: preparatory steps, tips for good beginning and end, delivery style, techniques for a good speech (repetition, signs, pictures, humor), body language		**02**	
3 UNIT: TECHNICAL Writing			**CO1 CO2 CO4**
3.1 Report **writing** Functions and parts of a report, Qualities of a good report, and types: Report on any institute function, Accident report, Industrial visit Report		04	
3.**2 Business letters** Principles of effective letter writing, parts of a business letter, formats (Full block style, Semi block style, modified block style) Routine/ Generic letters (letter to the heads of the institute, letter to the heads of various departments/sections of the institute) Types of letters: Enquiry Letter, Quotation, Purchase Order, Letter of Complaint		06	
3.3 **Job application** Tips for a good C.V and a Resume		02	
4 UNIT GRAMMAR	**-**		**CO1**

4.1 Fundamentals of English writing Subject verb agreement, homonyms, homophones, homographs, articles, Punctuation, synonyms, fundamentals of sentence construction		**02**	**CO2** **CO4**
4.2 Paragraph Writing: Developing Topics (the main idea), body (supporting sentences), conclusion, proof reading		**02**	
UNIT V: LANGUAGE WORKSHOP **5.1 Reading Skills** strategies to use for building vocabulary and reading fluencies (read extensively, identify new words, use of dictionary, online dictionary apps), reading comprehension, pronunciation, debate, role play,	-	08	**CO1** **CO2** **CO4**
5.2 Listening Skills How to listen effectively, listening comprehension			
5.3 Speaking skills speech, group discussion			
5.4 Writing skills précis writing, comprehension			
Total		**32**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, videos, exercises

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	NO of lectures	Marks
1	Fundamental of Communications skills	04	-
2	Presentation Skills	04	-
3	Technical Writing	12	-
4	Grammar	04	-
5	Language workshop	08	-
	Total	32	25

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	Practical
1.	**Practical Title: Fundamental of Communications skills**
i.	Comprehension
ii.	Précis writing
iii.	Self-Introduction
2	**Practical Title: Presentation Skills**
iv.	Extempore speech
v.	Presentation on any given Topic
3	**Practical Title: Technical Writing**
vi.	Accident Report
vii.	Report on Institute function
viii.	Industrial visit report
ix.	Generic letters to the heads of various department/ Sections of the institute
x.	Inquiry letter
xi.	Quotation
xii.	Purchase or supply order
xiii.	Complaint letter
xiv.	Job application

4	**Grammar**
xv.	Exercises in subject – verb agreement
xvi.	Exercises in use of preposition
xvii.	Exercises in use of Homophones, homonyms, homographs
xviii.	Exercises in use of punctuation
xix.	Exercises relating to correcting the sentences
xx.	Paragraph writing
5	**Language workshop**
xxi.	Exercises to improve Reading skills
xxii.	Exercises to improve Writing skills
xxiii.	Group discussion
xxiv.	Listening comprehension

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	R. C. Sharma & Krishna Mohan	Business Correspondence and Technical Writing	Tata McGraw Hill
2	P. Prasad, Sharma, K. Rajendra	The Functional aspects of communication skills	S.k. Kataria& sons
3	SanjayKumar,Pushpa Lata	Communication Skills	Oxford University Press
4	A.K.Jain,A.M.Shaikh&Pravin S R Bhatia	Professional communication Skills	S.Chand
5	Wren & Martin	High School English Grammar & Composition	S. Chand, N. Delhi

10.Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	Raul R. Timm	How to make winning presentations	Sneha Printers
2	Dale Carnegie, Training CPI	Stand and Deliver, How to become a masterful communicator and public speaker	Cox & Wyman, UK
3	John Seely	The Oxford Guide to Effective Writing and speaking	Oxford University Press

Autobiographies, self-help books, Audio speeches given by famous personalities

Internet and Web Resources

https://www.grammarly.com/
https://www.bbc.co.uk/programmes/articles/5QFnVy3xzT5htTh13cmP2P8/teacher-resources
https://Ted.com

Videos and Multimedia Tutorials

https://you.tu.be/AykYRO5d_II

(GC102) Engineering Mathematics I

1. COURSE OBJECTIVE:

1. The course is aimed at providing mathematical knowledge, developing computational skills and reasoning. It also helps students to think logically and in systematic manner so as to grasp mathematical concepts easily. It helps to build analytical thinking which play an important role in solving real world problems in all scientific discipline.

2.TEACHING AND EXAMINATION SCHEME

Semester	**I**							
Course code & course title		**Periods/Week (in hours)**			**Total hours**	**Examination Scheme**		
						Theory Marks	**Term Work**	**Total Marks**
(GC102) Engg.Maths I		**L**	**T**	**P**	**H**	**TH**	**TM**	**TW**
		4	**2**	**-**	**96**	**75**	**25**	**25**	**125**

3.COURSE OUTCOMES:

GC102.CO1. Understand the basic mathematical concepts for Engineering applications.

GC102.CO2. Identify and use appropriate formulae for solving practical engineering problems

GC102.CO3. Apply formulae of algebra, geometry, trigonometry and calculus for solving problems.

GC102.CO4 . Co-relate mathematical formulae to practical problems.

4.Mapping Course Outcomes with Program Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**
CO1	**3**	**2**	**1**	**0**	**0**	**0**	**2**
CO2	**3**	**3**	**1**	**0**	**1**	**0**	**1**
CO3	**2**	**2**	**3**	**3**	**2**	**0**	**1**
CO4	**2**	**3**	**3**	**2**	**1**	**1**	**1**

Relationship :Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	**Thr = Teaching hours**	**CO = Course Objectives**	

Unit	**Marks**	**Thr**	**CO**
1 MATHEMATICS FUNDAMENTAL	**8**	**6**	**CO1**
1.1 **Polynomials: Types** of polynomials, addition subtraction, (no question to be asked), Multiplication and division of polynomials	3	2	
1.2 **: Algebraic equations:**Different types of equations and their geometric meaning(line,circle parabola only) ,equations with one, two and three variables and solving equations with two and three variables Quadratic equations and nature of their solutions	3	2	
1.3: Logarithm: Definition of log, log with base 'e' and base'10' Properties of log, log and antilog , problems using definition and properties of log.	2	2	
2.STRAIGHT LINES AND CIRCLES	15	14	**CO1, CO4**
2.1: Straight line: Intercept, slope, intersection of lines Equations of line: 1. Slope intercept form, slope point form, two points form, parallel and perpendicular lines, angle between lines Perpendicular distance of a point from line	8	7	
2.2: Circle: circle as a locus, Centre, diameter, chord of a circle Equations of circle: Centre radius form, diameter form, general form and sums	7	7	
3. TRIGONOMETRY			**CO1, CO3**
3.1: Angle and measurement, degree and radians and conversion and related sums, arc length and area of sector and sums **3.2:** Trigonometric ratios and identities 3.3: Trigonometric ratios of compound and allied angles 3.4: Product formulae sinA$\pm$sinB, cosA$\pm$cosB **3.5:** Sum and difference formulae **3.6:** Multiple angle 2A, and their trigonometric ratios, **3.7**: Sine rule, Cosine rule in triangle, solution of triangle	12	15	
4 : MENSURATION	10	6	**CO1, CO4**
4.1: Areas of 2D figures like quadrilaterals, circle triangle etc (no questions to be asked) **4.2:** Surface area and volumes of cube, sphere, cylinder, cone, (no question to be asked)			

Surface areas and volumes of prism, pyramid, **4.3**: Frustum of cone, pyramid and their surface areas and volumes. **4.4:** Simpson's 1/3 rd rule for area and volume			
5 :CALCULUS	30	23	**CO1, CO2, CO3, CO4**
5.1:Limits 5.1.1 : Pre requisite : Sets , intervals, relation and function (no questions to be asked) 5.1.2 : Limit of a function , algebraic properties of limits 5.1.3: Limits of algebraic, trigonometric, exponential, logarithmic functions	7	6	
5.2 : Derivatives 5.2 .1: Derivative definition by first principle (no question to be asked) 5.2.2: Standard formulae, Algebraic properties of derivative (u±v) etc. 5.2.3: Derivatives of algebraic, trigonometric, exponential, logarithmic functions 5.2.4: Derivative of product of functions (uv rule). 5.2.6: Derivative of quotient of functions (u/v rule) 5.2.7: Derivative of composite functions 5.2.8: Derivative of parametric functions 5.2.9: Derivative of implicit functions 5.2.10 : Logarithmic differentiations 5.2.11: Second order derivatives (no question to be asked)	15	12	
5.3 : Applications of derivatives 5.3.1: Application to the geometry: i) derivative as a slope of a tangent ii) to find equations of tangent and normal at given point on the curve 5.3.2: Application to the Linear motion:i) displacement, velocity,acceleration 5.3.3: Application to the rate measure i) to find rate change in area and volume etc 5.3.4 : Maxima and minima	8	5	
Total	**75**	**64**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises

7. SPECIFICATION TABLE FOR THEORY

Unit No	Unit	Number of lectures	Marks
1	**Mathematics Fundamental**	06	8
2	**Straight line and circle**	14	15
3	**Trigonometry**	15	12
4	**Mensuration**	06	10
5	**Calculus**	23	30
	Total	**64**	**75**

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

- Tutorial books should be maintained by students (5 marks)
- Two home assignments per semester (5 marks)

  The Two assignments each comprises of thirty questions which includes 15 short questions and fifteen long questions. First assignment will cover fifty percent of syllabus

  and second assignment will cover remaining portion of syllabus
- Topic-wise class assignment (15 marks)

  Class assignment comprises of ten short and ten long questions.

9. LEARNING RESOURCES

Text Books

S. No.	Title of Books	Author	Publishers
1	Mathematics for Polytechnic Students(Basic Mathematics)	S.P. Deshpande	Pune VidyarthiGrihaPrakashan 1786, Sadashiv Peth, Pune
2	Mathematics for Polytechnic Students(Engineering Mathematics)	S.P. Deshpande	Pune VidyarthiGrihaPrakashan 1786, Sadashiv Peth, Pune
3	S.B. Gore, M.B.Patil, S.P. Pawar	Applied Mathematics	Vrinda Publications

Reference Books for further study

S. No.	Title of Books	Author	Publishers
1	Applied Mathematics I	Dr. U.B.Jangam, K.P. Patil, Nalini Kumthekar	Nandu Printers& Publishers pvt. Ltd. Mumbai
2	Applied Mathematics for Polytechnics	H.K. Dass	CBS Publishers and distributers Pvt.Ltd. ,Pune
3	Set Theory and related topics	Seymour Lipschutz	McGraw-Hill

(GC103) APPLIED PHYSICS-I

1.COURSE OBJECTIVE :

On successful completion of the course, Students completing the Applied Physics I course will be able to demonstrate competency and understanding of the basic concepts found in, Units and Dimensions, Kinematics of motion in one dimension Force Work Power and Energy, Circular Motion and Gravitation, Properties of Matter and Heat and will be able to utilize the knowledge to demonstrate competency with experimental methods that are used to discover and verify the concepts related to content knowledge

2.TEACHING AND EXAMINATION SCHEME

Semester I									
Course code & course title	Periods/Week (in hours)			Total Hours	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
(GC103) Applied Physics I	L	T	P	H	TH	TM	TW	PR/OR	
	03	0	02	80	75	25	25	-	125

3.COURSE OUTCOMES:

GC103.CO1: Understand the Fundamental concepts of physical quantities, Force, Power, Energy, Motion, Matter and heat transfer used in Engineering applications.

GC103.CO2: Explain the concepts of Dimensions, Work, Power , Energy ,Motion, properties of matter and heat transfer

GC103.CO3: Apply the Knowledge of Physical quantities, Types of motions, Force, work ,Power, properties of matter and heat transfer in Engineering applications

GC103. CO4: Analyze different types of Physical quantities, motions, properties of matter, and modes of heat transfer

4. Mapping Course Outcomes with Program Outcomes

Relationship: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Devlopment of Solutions	Engg. Tools, Experimentatn& Testing	Engg. Practices for Society,Sustainability& Environment	Project Management	Life -long Learning
CO 1	3	1	1	3	2	0	3
CO 2	3	1	2	3	0	0	3
CO 3	3	1	2	2	0	1	1
CO 4	1	1	2	2	0	1	1

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks | **Thr = Teaching hours** | **CO = Course Outcomes**			
Unit	**Thr**	**M**	**CO**
1 UNIT NAME: UNITS AND DIMENSIONS	**08**	**12**	**CO1, CO2, CO3, CO4**
1.1 Fundamental and Derived units ,			
1.2 Different system of units, SI unit conversion from one system to other,			
1.3 Principle of Homogeneity,			
1.4 Dimensions, dimensional formula,			
1.5 dimensonal correctness of given equation using dimensions			
1.6 least count of vernier calliper and screw gauge			
1.7 zero errors-- in case of vernier calliper and screw gauge			
1.8 Types of error.			
2. UNIT NAME: MOTION IN ONE DIMENSION, FORCE, WORK,POWER AND ENERGY	**10**	**16**	**CO1, CO2, CO3, CO4**
2.1 Distance and displacement,			
2.2 Scalar and Vectors			
2.3**,** Speed and Velocity, Uniform Velocity, ,			
2.4 Uniform acceleration,acceleration due to gravity			
2.5 Equation of motion (v=u+at, $v^2=u^2+2as$, $s=ut+1/2at^2$)(no derivation)			
2.6 Motion under gravity. Force and its unit.			
2.7 Work and its unit. Energy, law of conservation of energy,			
2.8. Kinetic and Potential energy equation and examples.			
3. UNIT NAME: Uniform Circular Motion and Gravitation	**10**	**16**	**CO1, CO2, CO3, CO4**
3.1 Unifrom circular motion,			
3.2 Definition angular displacement,angular velocity, ,			
3.3 Conversion from rpm to rad/sec,v=rω, tangential velocity, radial acceleration			
3.4 Centripetal force and centrifugal force, examples,			
3.5 Banking of roads,superelevation, expression for angle of banking			
3.6 Newtons law of gravitation, acceleration due to gravity ,			
3.7 Expression for acceleration due to gravity. Escape velocity, Critical velocity, and periodic time definition and expression (no derivation)			
3.8. Sattellite, types(Geosationary,communication remote sensing)			
4. UNIT NAME: PROPERTIES OF MATTER	**10**	**16**	**CO1, CO2, CO3, CO4**
4.1 Elasticity ,			
4.2 Stress, Strain,Hooke's law,			
4.3 Youngs Modulus,			
4.4 Bulk Modulus, Rigidity Modulus,			
4.5 Stress v/s Strain graph			
4.6 Yield point, breaking stress,factor of safety, ,			
4.7 Surface tension definition and example			
4.8. Adhesive and cohesive force, application,			
4.9 liquid miniscus and angle of contact, capillarity,			
4.10 Expression for surface tension (no derivation), applications. viscocity,			
4.11 Definition velocity gradient, newtons law of viscocity, terminal velocity,stokes law,			
4.12 Streamline flow and turbulent flow,critical velocity, application of viscocity.			
5. UNIT NAME: HEAT	**10**	**15**	**CO1, CO2, CO3,**
5.1 Statements of boyles law,charles law,gay lussacs law			
5.2 General gas equation,specific heat definition and unit, Latent heat			

definition and unit			**CO4**
5.3 Modes of transfer of heat, conduction, convection and radiation,			
5.4 Conduction of heat through a metall rod,			
5.5 Variable and Steady state			
5.6 law of thermal conductivity (With Derivation)			
5.7 Applications of thermal conductivity, ,			
5.8. Thermal expansion of solids			
5.9 linear expansion,superficial expansion,			
5.10 Cubical Expansion			
5.11 Realtion betwenn α,β,γ (no derivation)			
5.12 Engineering applications of expansion of solids.			

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies.

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	**Unit**	**Number of lectures**	**Marks**
1	UNITS AND DIMENSIONS	8	12
2	MOTION IN ONE DIMENSION, FORCE, WORK AND ENERGY	10	16
3	UNIFORM CIRCULAR MOTION AND GRAVITATION	10	16
4	PROPERTIES OF MATTER	10	16
5	HEAT	10	15
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS

No	**Practicals**	**Marks**
1.	Basic Conversion Techniques from one system of units to the other	25
2.	Use of Vernier callipers to find the Volume of Hollow cylinder, Block	25
3.	Use of Screw gauge to find the cross-sectional area of a wire and thickness of a clip	25
4.	To find the Coefficient of Viscosity of a given liquid by stokes method	25
5.	To Find the coefficient of Thermal Conductivity by Searle's Method	25
6	To Find the Surface Tension of a given liquid by capillary rise method	25
7	To Find Young's Modulus by Searles Method	25
8	To Find acceleration due to gravity by simple pendulum method.	25
	Total (Average)	25

9. LEARNING RESOURCES

Text Books

S. No.	**Author**	**Title of Books**	**Publishers**
1	B G Dhande	Applied Physics of Polytechnics	Pune Vidyarthi Griha Prakashan
2	Bhandarkar	Applied Physics of Polytechnics	Vrinda publication
3	R K Gaur and S L Gupta	Engineering Physics	Dhanpat Rai & Sons Delhi
4	Dr. Vasudev R Bhagwat	A Text Book of Applied Physics for Polytechnics	Broadway Publishing House
5	B L Thereja	Engineering Technology	S. Chand

Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	Halliday D and Resnick	Physics Part I-II	Wiley Eastern Ltd.
2	Satish k. Gupta	ABC of Physics I&II	Modern Publisher
3	Saxena HC and Singh Prabhakar	Applied Physics Vol I & II	S. Chand Publisher

(GC104) Applied Chemistry

1. COURSE OBJECTIVE:

Chemistry is the branch of Science which deals with the study of composition, properties and changes in matter. An understanding of the basic concepts of Applied Chemistry, chemical principles and chemical properties of materials is essential to all the engineers. The emphasis is on applying the knowledge of principles of chemistry in all the fields of engineering wherein students appreciate the significance of chemistry in day to day life. The subject develops in students the habit of scientific enquiry, the ability to investigate cause and effect relationship & the ability to interpret & analyze the results.

2. TEACHING AND EXAMINATION SCHEME

Semester	**I**								
Course code & course title		**Periods/Week (in hours)**			**Total Credits (Hours)**	**Examination Scheme**			
						Theory Marks		**Practical Marks**		**Total Marks**
(GN104) Applied Chemistry		**L**	**T**	**P**	**H**	**TH**	**TM**	**TW**	**PR/OR**	
		3	**-**	**2**	**80**	**75**	**25**	**25**	**-**	**125**

3. COURSE OUTCOMES:

GC 104.CO1: Understand the fundamental concepts of Atomic Structure, electrochemistry, water quality, corrosion and polymers.

GC 104.CO2: Explain the process of Chemical bonding, water softening, electroplating, corrosion control and polymerization

GC 104.CO3: Relate the principles of Chemical Bonding, Electrolysis, water hardness for domestic and Industrial applications and properties of polymers.

GC 104.CO4: Distinguish between types of Chemical bonding, Water softening methods, corrosion control methods, different processes of metal coating and different polymers.

4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimenting& Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
CO1	3	2	1	1	2	1	1
CO2	2	3	2	1	3	1	2
CO3	3	2	2	2	3	1	2
CO4	3	2	2	2	2	1	1

Relationship : Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks | **Thr = Teaching hours** | **CO = Course Objectives**			
Unit	**Mks**	**Thr**	**CO**
UNIT 1.0 : ATOMIC STRUCTURE AND CHEMICAL BONDING	**15**	**10**	CO1 CO2 CO3 CO4
1.1 Atomic Structure 1.1.1 Fundamental particles and their characteristics. 1.1.2 Energy levels - Definition & designation 1.1.3 Sub Energy levels- Definition & designation 1.1.4 Orbital – Concept & shape (s and p only) **1.2** Quantum numbers 1.2.1 Designation, definition, values.			
1.3 Electronic distribution (Elements from atomic Number 1-20) 1.3.1 Bohr – Bury's laws for distribution of electrons in shells (1st three laws only) 1.3.2 Aufbau Principle. for distribution of electrons in sub-shells 1.3.3 Pauli's Exclusion Principle. 1.3.4 Hund's Rule of maximum multiplicity 1.3.5 Orbital Electronic Configuration of elements (from atomic numbers 1 to 20 only).			
1.4 Chemical Bonding 1.4.1 Lewis and Longmuir concept of stable configuration. 1.4.2 Electrovalent - Bond - Concept Formation of Electrovalent Compound (NaCL & MgO) 1.4.3 Covalent Bond – Concept Formation of Colvalent Compounds (Cl_2, O_2, N_2) 1.4.4 Co-ordinate Bond - Concept Formation of Co-ordinate Compounds (O_3) 1.4.5 Properties of Electrovalent, Colvalent & Co-Ordinate compounds.			
UNIT 2.0 : WATER	**15**	**10**	CO1 CO2 CO3 CO4
2.1 Hardness of Water 2.1.1 Soft and Hard Water - Concept Soap Test (Chemical Equation not expected) 2.1.2 Causes of Hardness 2.1.3 Types of Hardness 2.1.4 Degree of Hardness & Units of Hardness (mg/L & ppm)			
2.2 Disadvantages of Hard Water 2.2.1 Domestic Purpose Drinking, cooking, Washing & Bathing. 2.2.2 Industrial Purpose (Paper Industry, Textile & Dyeing Industry, Sugar Industry, Bakery & Concrete Making) 2.2.3 Boilers- Steam Generation Purpose. Sludge formation – causes & Disadvantages (No chemical equation expected)			
2.3 Water Softening			

2.3.1 Zeolite and Ion Exchange process of water softening			
2.4 Desalination of water 2.4.1 Electrodialysis & Reverse Osmosis process. 2.4.2 pH- Concept, pH scale & Importance of pH			
UNIT 3.0 : <u>ELECTROCHEMISTRY</u>	**12**	**08**	CO1 CO2 CO3 CO4
3.1 Electrolytic dissociation 3.1.1 Arrhenius theory of Electrolytic dissociation 3.1.2 Factors affecting degree of Ionization- nature of solute, nature of solvent, concentration of solution and temperature.			
3.2 Electrolysis 3.2.1 Mechanism of Electrolysis. Ionization Reactions Reactions at cathode, Activity series of Cations. Reactions at Anode, Activity series of Anions. 3.2.2 Electrolysis of Molten NaCl using Carbon Electrodes. Aqueous NaCl using Platinum Electrodes. Aqueous $CuSO_4$ using Platinum Electrodes. Aqueous CuSO4 using copper Electrodes.			
3.3 Electrochemical series – Definition and Significance			
UNIT 4.0 : CORROSION AND ITS CONTROL	**25**	**14**	CO1 CO2 CO3 CO4
4.1 Dry /Direct Chemical corrosion 4.1.1 Definition 4.1.2 Oxidation corrosion 4.1.3 Corrosion due to other gases.			
4.3 Types of Electrochemical corrosion. 4.3.1 Galvanic Cell corrosion 4.3.2 Concentration cell corrosion(Metal ion concentration & differential Aeration)			
4.4 Corrosion Control Protection of metals by: 4.4.1. Using Pure Metals & Metal alloys 4.4.2 Proper designing 4.4.3 Modifying the environment (De- aeration, Deactivation, Dehumidification, Alkaline neutralization) 4.4.4 Cathodic protection (Sacrificial anode and Impressed current cathodic protection) 4.4.5 Metal Coating (Galvanizing, Tinning, Metal-Spraying, Electroplating & powder coating)			
UNIT 5: POLYMERS	**08**	**06**	CO1 CO2 CO3 CO4
5.1 Concept of Monomers & Polymers			

5.2 Polymerization- Definition. 5. 2.1 Addition polymerization-Definition. 5.2.2 General equation of polymerization of :- Ethylene to Polyethylene. Vinyl chloride to Polyvinylchloride Tetra fluoro ethylene to Poly tetra fluoroethylene(PTFE) 5.2.3 Condensation Polymerization-Definition 5.2.4 General Equation for formation of Phenol formaldehyde Resin. **5.3** Plastics. 5.3.1 Types of plastic (Thermosetting and Thermo softening), Examples 5.3.2 Properties and applications of Poly-ethylene, PVC, polystyrene, Nylons, Bakelite & silicones.			
5.4 Rubber 5.4.1 Natural Rubber 5.4.2 Drawbacks of Crude rubber. 5.4.3 Vulcanization of Rubber (General Equation) 5.4.4 Rubber examples. 5.4.5 Properties of Synthetic Rubber & related applications.			

8. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

9. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	**Unit**	**Number of lectures**	**Marks**
1	**ATOMIC STRUCTURE AND CHEMICAL BONDING**	10	15
2	**WATER**	10	15
3	**ELECTROCHEMISTRY**	08	12
4	**CORROSION & IT'S CONTROL**	14	25
5	**POLYMERS**	06	08
	Total	**48**	**75**

10. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	Practical
	Practical Title
1.	Double Acid-Base Titration using Phenolphthalein.
2.	Acid- Base titration using Methyl orange.
3.	Redox Titration of $KMnO_4$ soln., $FeSO_4$ soln. and Oxalic acid
4.	Determination of degree of Hardness by E.D.T.A method.
5.	Determination of Total Alkalinity of water sample.
6.	Determination of Chloride content of water sample by Mohr's method.
7.	pH- Metric titration.
8.	Conduct metric Titration.
9.	Determination of Conductivity of water samples from different water body sources.
10.	Corrosion Susceptibility of Aluminum to Acid or Base.
11.	Determination of pH of different food items.
	Total Marks: 25
	No Class room Assignments

*** Any TEN of the above.**

****Term Work Assessment Scheme**:1. Performance:15 marks (Carrying out experiment, Readings, Calculations and Results)
2.Knowledge :05 Marks(Theory of the experiment)
3. Journal : 05 Marks

11. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	M.M. Uppal	Text book of Engg. Chemistry	Khanna Publisher
2	V.P.Mehta	Text book of Engg. Chemistry	Jain Bros. Delhi
3	S.N Narkhede	Textbook of Engg. Chemistry	Niraj Prakashan
5	S S Dara	A Textbook of Engg. Chemistry	S Chand & Co
4	P.C. Jain and M.Jain	Engg. Chemistry.	Dhanpat Rai Publishing Co.

(GC105) Basic Engineering Practice (Electronics& Comp.)

1. COURSE OBJECTIVE:

The students will be able to acquire knowledge about safety aspects, firefighting, first-aid and carpentry, fitting, plumbing skills. The students will learn proper ways of using various hand tools, measuring devices in acquiring these skills and will also interpret simple electrical drawings/circuit diagrams.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/ Week (In Hours)			Total Hours	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
(GC 106)	L	T	P	H	TH	TM	PR/OR	TW	
Basic Engineering Practice	0	0	5	80	-	-	50	100	150

3. COURSE OUTCOMES:

PART A

On successful completion of the course, the student will be able to:
GC106.CO1. Understand safety procedures to be followed in carpentry, fitting, and plumbing.
GC106.CO2. Identify various tools used for carpentry, fitting, and plumbing.
GC106.CO3: Demonstrate basic working skills in carpentry, fitting and plumbing.

GC106.CO4: Plan & execute a job/activity using job drawing.

PART B

On successful completion of the course, the student will be able to:
GC106.CO1. List the safety measures.to be observed in electrical workshop.
GC106.CO2. Identify various electrical tools, fittings used for electrical measurements & troubleshooting.
GC106.CO3: Distinguish between single phase and three phase supply.

GC106.CO4: Plan & execute a job/activity from electrical circuit drawing.

4. MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES

PART A

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation& Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
CO1	2	1	1	3	2	2	3
CO2	2	1	2	3	2	2	2
CO3	2	1	1	3	2	2	2
CO4	2	1	3	3	2	3	2

Relationship: Low-1 Medium-2 High-3

PART B

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation& Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
CO1	2	1	1	3	2	2	3
CO2	2	1	2	3	2	2	2
CO3	3	1	1	2	2	1	2
CO4	2	1	3	3	2	3	2

Relationship: Low-1 Medium-2 High-

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks | **Hr = Practical Hours** | **CO = Course Outcomes**			
Unit	**M**	**Hr**	**CO**
1 General Safety, Housekeeping, Fire Fighting & First Aid	10	06	
1.1Introduction to General Safety aspects of engineering workshop 1.2 Meaning and importance of housekeeping. 1.3 Fire hazards, fire triangle, types of fire extinguishers – selection and use. 1.4Basic knowledge of first aid with specific inputs on cuts, burns, electric shocks, artificial respiration, handling emergencies.			CO1
2 Fitting Workshop Practice	30	18	
2.1 Introduction to the trade. 2.2 Introduction to various hand Tools, Measuring and Marking Tools, cutting tools, Holding tools, Striking tools 2.3 Types of files and filing methods. 2.4 Drill bits and drilling Processes, using portable and pillar drilling machine. 2.5 Operations performed in fitting shop such as measuring, marking, chipping, filing, grinding, sawing, drilling 2.6 Threading using taps and dies.			CO1 CO2 CO3
3 Carpentry Workshop Practice	20	18	
3.1 Introduction to carpentry 3.2 Types of wood and its characteristics, forms of wood, defects in timber and its identification, wood working hand tools 3.3 Wood working processes. 3.4 Different types of joints and their usage. 3.5 Introduction to wood working machines: 3.6 Lathe 3.7 Circular saw 3.8 Band saw 3.9 Wood planner 3.10 Universal wood working machine			CO1 CO2 CO3
4 Electrical Workshop Practice	30	32	
4.1 Brief introduction to power distribution and Electrical Safety. 4.2 Use of different hand tools used in electrical trade 4.3 Collection of details of motors and transformers. 4.4Introduction to Control Panel and its various sections/components. 4.5 Making of wire joints. 4.6Measurement of current, voltage, frequency and Power Consumption. 4.7 Connecting and starting of Induction Motor & Measurement of its speed. Changing of Direction of rotation of induction motor. 4.8 Introduction to commonly used electrical Fittings (Domestic & Industrial). 4.9Wiring of Simple Electric Circuit (Bulb & plug point and switches) on wooden board 4.10 Study, connection & use of Energy Meter 4.11Testing of components using Series test lamp & Multimeter 4.12Study of Fuses & practice replacement of Fuse 4.13 Study & Troubleshooting of Tube Light			CO1 CO2 CO3 CO4
5 Plumbing	10	06	
5.1Plumbing tools, pipe fittings and method of joining pvc pipes.			CO1

5.2 Use of spirit level and plumb bob. 5.3 Minor repairs and replacement of fittings. 5.4 Reading of plumbing drawings. *[Note: Plumbing restricted to domestic plumbing and pvc piping.]*			CO2 CO3
Total	**100**	**80**	

6. COURSE DELIVERY:

The Course will be delivered through workshop practical sessions in mechanical and electrical workshops.

7. SPECIFICATION TABLE FOR PRACTICALS/ MACRO-LESSON PLAN

Unit No	Unit	Number of hrs.	Marks
1	General Safety, Housekeeping, Fire Fighting & First Aid	06	10
2	Fitting Workshop Practice	18	30
3	Carpentry Workshop Practice	18	20
4	Electrical Workshop Practice	32	30
5	Plumbing	06	10
	Total	80	100

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	Practical	Hrs.
1	**General Safety, Housekeeping, Fire Fighting & First Aid**	**06**
a	Demonstration on use of Safety Measures while working in Workshop and use of safety signs.	03
b	Demonstration on use of First Aid and Artificial Respiration procedure ,Training on fire and emergency services (using video presentation /fire and safety expert talk)	03
2	**Fitting Workshop Practice**	**18**
a	Identification of various hand Tools, Measuring and Marking Tools, cutting tools, Holding tools, Striking tools	03
b	Identification of various types of files and demonstration on filing methods.	03
c	Identification of various types of Drill bits, taps, dies and Drilling machines such as portable and Pillar Drilling machine.	03
d	Job involving filing, marking, cutting operation on MS Flat.	06
e	Job involving Drilling and Tapping operation on MS flat.	03
3	**Carpentry Workshop Practice**	**18**
a	Identification of various types of woods and wood working hand tools	03
b	Identification of various types of Carpentry joints and their usage.	03
c	Introduction to wood working machines such as wood working Lathe, Circular saw ,Band saw, Wood planner, Universal wood working machine	03
d	Job involving marking, measuring, planning, sawing, chiseling, joint preparation and assembly of wooden blocks.	06
e	Preparation of job on wood working lathe.	03
4	**Electrical Workshop Practice**	**32**
a	Measurement of Single Phase and Three Phase supply Voltage using multimeter.	02
b	Identification of various hand tools used in electrical trade.	02
c	Measurement of electric circuit parameters using Ammeter, Voltmeter, Frequency meter, Wattmeter.	04
d	Making of Straight and T wire joints.	02
e	Testing of electrical components such as Choke, starter, Fuse, Switch using	02

	Series Test lamp and Multimeter	
f	Starting of induction motor using DOL Starter	02
g	Reversal of direction of rotation of Three phase induction motor	02
h	Identification of commonly used electrical fittings.	02
i	Wiring of simple electrical circuit using bulb and socket.	04
j	Measurement of Energy using Energy Meter.	02
k	Identification of Different types of Fuses and their replacement in circuit.	02
l	Testing of various components and connection of Tube light circuit.	02
m	Collecting Name plate Details of Motors and Transformers and operating and controlling speed of motor from Control panel.	04
5	**Plumbing**	**06**
a	Identification of Plumbing tools and pipe fittings , Reading of plumbing drawings, methods of joining PVC pipes, use of spirit level and plumb bob in piping.	03
b	To carry out minor repairs and replacement of fittings.	03

9. LEARNING RESOURCES

TEXT BOOKS

S. No.	Author	Title of Books	Publishers
1	N. Sesha Prakash	Manual of Fire Safety	CBS Publishers and Distributers
2	S.K. Hajara-Chaudhary	Workshop Technology	Media Promoters
3	B.S. Raghuwanshi	Workshop Technology-	Dhanpat Rai and sons, New Delhi
4	R K Jain-	Production Technology	Khanna Publishers, New Delhi
5	H. S .Bawa	Workshop Technology	Tata McGraw Hill Publishers, New Delhi
6	Kent	Mechanical Engineering Hand book	John Wiley and Sons, New York
7	B.L. Theraja	Fundamentals of Electrical Engineering and Electronics	S. Chand – New Delhi

REFERENCE BOOKS FOR FURTHER STUDY

S. No.	Author	Title of Books	Publishers
1	CIMI- Central Instructional Media Institute Madras	Turner – Trade Theory – Ist and IInd Year	Wiley Eastern Ltd. New Delhi

(GC106) Basic Engineering Practice (Mech & Elect.)

1. COURSE OBJECTIVE:

The students will be able to acquire knowledge about safety aspects, firefighting, first-aid and carpentry, fitting, plumbing skills. The students will learn proper ways of using various hand tools, measuring devices in acquiring these skills and will also interpret simple electrical drawings/circuit diagrams.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/ Week (In Hours)			Total Hours	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
(GC 106)	L	T	P	H	TH	TM	PR/OR	TW	
Basic Engineering Practice	0	0	5	80	-	-	50	75	125

3. COURSE OUTCOMES:

PART A

On successful completion of the course, the student will be able to:
GC106.CO1. Understand safety procedures to be followed in carpentry, fitting, and plumbing.
GC106.CO2. Identify various tools used for carpentry, fitting, and plumbing.
GC106.CO3: Demonstrate basic working skills in carpentry, fitting and plumbing.

GC106.CO4: Plan & execute a job/activity using job drawing.

PART B

On successful completion of the course, the student will be able to:
GC106.CO1. List the safety measures.to be observed in electrical workshop.
GC106.CO2. Identify various electrical tools, fittings used for electrical measurements & troubleshooting.
GC106.CO3: Distinguish between single phase and three phase supply.

GC106.CO4: Plan & execute a job/activity from electrical circuit drawing.

4. MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES

PART A

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation& Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
CO1	2	1	1	3	2	2	3
CO2	2	1	2	3	2	2	2
CO3	2	1	1	3	2	2	2
CO4	2	1	3	3	2	3	2

Relationship: Low-1 Medium-2 High-3

PART B

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation& Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
CO1	2	1	1	3	2	2	3
CO2	2	1	2	3	2	2	2
CO3	3	1	1	2	2	1	2
CO4	2	1	3	3	2	3	2

Relationship: Low-1 Medium-2 High-

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks | **Hr = Practical Hours** | **CO = Course Outcomes**			
Unit	**M**	**Hr**	**CO**
1 General Safety, Housekeeping, Fire Fighting & First Aid		06	
1.1Introduction to General Safety aspects of engineering workshop 1.2 Meaning and importance of housekeeping. 1.3 Fire hazards, fire triangle, types of fire extinguishers – selection and use. 1.4Basic knowledge of first aid with specific inputs on cuts, burns, electric shocks, artificial respiration, handling emergencies.			CO1
2 Fitting Workshop Practice		18	
2.7 Introduction to the trade. 2.8 Introduction to various hand Tools, Measuring and Marking Tools, cutting tools, Holding tools, Striking tools 2.9 Types of files and filing methods. 2.10 Drill bits and drilling Processes, using portable and pillar drilling machine. 2.11 Operations performed in fitting shop such as measuring, marking, chipping, filing, grinding, sawing, drilling 2.12 Threading using taps and dies.			CO1 CO2 CO3
3 Carpentry Workshop Practice	20	18	
3.10 Introduction to carpentry 3.11Types of wood and its characteristics, forms of wood, defects in timber and its identification, wood working hand tools 3.12 Wood working processes. 3.13 Different types of joints and their usage. 3.14 Introduction to wood working machines: a. Lathe b. Circular saw c. Band saw d. Wood planner e. Universal wood working machine			CO1 CO2 CO3
4 Electrical Workshop Practice	30	32	
4.1 Brief introduction to power distribution and Electrical Safety. 4.2 Use of different hand tools used in electrical trade 4.3 Collection of details of motors and transformers. 4.4 Introduction to Control Panel and its various sections/components. 4.5 Making of wire joints. 4.6Measurement of current, voltage, frequency and Power Consumption. 4.7 Connecting and starting of Induction Motor & Measurement of its speed. Changing of Direction of rotation of induction motor. 4.8 Introduction to commonly used electrical Fittings (Domestic & Industrial). 4.9Wiring of Simple Electric Circuit (Bulb & plug point and switches) on wooden board 4.10 Study, connection & use of Energy Meter 4.11Testing of components using Series test lamp & Multimeter 4.12Study of Fuses & practice replacement of Fuse 4.13 Study & Troubleshooting of Tube Light			CO1 CO2 CO3 CO4
5 Plumbing		06	

5.1 Plumbing tools, pipe fittings and method of joining pvc pipes. 5.2 Use of spirit level and plumb bob. 5.3 Minor repairs and replacement of fittings. 5.4 Reading of plumbing drawings. *[Note: Plumbing restricted to domestic plumbing and pvc piping.]*			CO1 CO2 CO3
Total		**80**	

6. COURSE DELIVERY:

The Course will be delivered through workshop practical sessions in mechanical and electrical workshops.

7. SPECIFICATION TABLE FOR PRACTICALS/ MACRO-LESSON PLAN

Unit No	**Unit**	**Number of hrs.**	**Marks**
1	General Safety, Housekeeping, Fire Fighting & First Aid		10
2	Fitting Workshop Practice		30
3	Carpentry Workshop Practice		20
4	Electrical Workshop Practice		30
5	Plumbing		10
	Total		100

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	**Practical**	**Hrs.**
1	**General Safety, Housekeeping, Fire Fighting & First Aid**	**06**
a	Demonstration on use of Safety Measures while working in Workshop and use of safety signs.	03
b	Demonstration on use of First Aid and Artificial Respiration procedure ,Training on fire and emergency services (using video presentation /fire and safety expert talk)	03
2	**Fitting Workshop Practice**	**18**
a	Identification of various hand Tools, Measuring and Marking Tools, cutting tools, Holding tools, Striking tools	03
b	Identification of various types of files and demonstration on filing methods.	03
c	Identification of various types of Drill bits, taps, dies and Drilling machines such as portable and Pillar Drilling machine.	03
d	Job involving filing, marking, cutting operation on MS Flat.	06
e	Job involving Drilling and Tapping operation on MS flat.	03
3	**Carpentry Workshop Practice**	**18**
a	Identification of various types of woods and wood working hand tools	03
b	Identification of various types of Carpentry joints and their usage.	03
c	Introduction to wood working machines such as wood working Lathe, Circular saw ,Band saw, Wood planner, Universal wood working machine	03
d	Job involving marking, measuring, planning, sawing, chiseling, joint preparation and assembly of wooden blocks.	06
e	Preparation of job on wood working lathe.	03
4	**Electrical Workshop Practice**	**32**
a	Measurement of Single Phase and Three Phase supply Voltage using multimeter.	02
b	Identification of various hand tools used in electrical trade.	02
c	Measurement of electric circuit parameters using Ammeter, Voltmeter,	04

	Frequency meter, Wattmeter.	
d	Making of Straight and T wire joints.	02
e	Testing of electrical components such as Choke, starter, Fuse, Switch using Series Test lamp and Multimeter	02
f	Starting of induction motor using DOL Starter	02
g	Reversal of direction of rotation of Three phase induction motor	02
h	Identification of commonly used electrical fittings.	02
i	Wiring of simple electrical circuit using bulb and socket.	04
j	Measurement of Energy using Energy Meter.	02
k	Identification of Different types of Fuses and their replacement in circuit.	02
l	Testing of various components and connection of Tube light circuit.	02
m	Collecting Name plate Details of Motors and Transformers and operating and controlling speed of motor from Control panel.	04
5	**Plumbing**	**06**
a	Identification of Plumbing tools and pipe fittings , Reading of plumbing drawings, methods of joining PVC pipes, use of spirit level and plumb bob in piping.	03
b	To carry out minor repairs and replacement of fittings.	03

9. LEARNING RESOURCES

TEXT BOOKS

S. No.	Author	Title of Books	Publishers
1	N. Sesha Prakash	Manual of Fire Safety	CBS Publishers and Distributers
2	S.K. Hajara-Chaudhary	Workshop Technology	Media Promoters
3	B.S. Raghuwanshi	Workshop Technology-	Dhanpat Rai and sons, New Delhi
4	R K Jain-	Production Technology	Khanna Publishers, New Delhi
5	H. S .Bawa	Workshop Technology	Tata McGraw Hill Publishers, New Delhi
6	Kent	Mechanical Engineering Hand book	John Wiley and Sons, New York
7	B.L. Theraja	Fundamentals of Electrical Engineering and Electronics	S. Chand – New Delhi

REFERENCE BOOKS FOR FURTHER STUDY

S. No.	Author	Title of Books	Publishers
1	CIMI- Central Instructional Media Institute Madras	Turner – Trade Theory – Ist and IInd Year	Wiley Eastern Ltd. New Delhi

(GC201) ENGINEERING MATHEMATICS II

1. COURSE OBJECTIVE:

The course is aimed at providing mathematical knowledge, developing computational skills and reasoning. It also helps students to think logically and in systematic manner so as to grasp mathematical concepts easily. It helps to build analytical thinking which play an important role in solving real world problems in all scientific discipline.

2. TEACHING AND EXAMINATION SCHEME

Semester	**II**								
Course code & course title		**Periods/Week (in hours)**			**Total hours**	**Examination Scheme**			
						Theory Marks		**TERM WORK**		**Total Marks**
(GC201) Engineering Mathematics II		**L**	**T**	**P**	**H**	**TH**	**TM**	**TW**	**PR/OR**	
		4	**2**	**-**	**96**	**75**	**25**	**25**	**-**	**125**

3.COURSE OUTCOMES:

GC201.CO1: Understand the basic principles of Matrices ,Integration, Determinants and Vectors in engineering problems.
GC201.CO2: Interpret the formulae to solve problems of Matrices ,Integration, Determinants and Vectors.
GC201.CO3: Apply appropriate mathematical methods for solving engineering problems.
GC201.CO4: Analyse the knowledge of Matrices ,Integration, Determinants and Vectors for various Engineering applications.

4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO1	3	1	1	2	0	2	2
CO2	3	1	1	2	0	2	2
CO3	2	2	2	3	1	2	2
CO4	1	3	2	3	1	2	2

Relationship : Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	**Thr = Teaching hours**	**CO = Course Objectives**			
Unit			**Marks**	**Thr**	**CO**
1 .DETERMINANTS AND MATRICES			**15**	**12**	**CO1, CO2, CO4**
1.1 **Determinants**: Definition & order of determinant, value of determinant, properties of determinants(no question), Cramer's rule for solving equations with two & three variables			7	4	
1.2 **Matrices**: - Definition & order of matrix, types of matrices, Equality of matrices, addition & subtraction, multiplication of matrices, adjoint & inverse of a matrix , solution of linear equations with two & three variables using matrices			8	8	
2 .INTEGRATION			20	22	**CO1, CO2, CO4**
Definition, Standard Formulae, properties of Integration for sum, difference and scalar multiplication, integration of algebraic, trigonometric, inverse trigonometric, exponential, logarithmic, composite function, Integration by substitution, integration by partial fraction, integration by parts					
3 .DEFINITE INTEGRALS			10	08	**CO3**
Definition of definite integral and Properties of definite integral ,integration by parts Applications:Area under the curves & lines and area between the curves and Volumes (simple problems)					
4 .VECTORS			15	12	**CO1, CO2, CO4**
Definition of scalars & vectors, equality of vectors, Addition & subtraction of vectors, triangle, parallelogram laws for addition, position vector, dot product & cross product and their properties and applications, relation between dot and cross product and scalar triple product and applications					
5 .STATISTICS / COMPLEX NUMBERS			15	10	**CO3**
Statistics : **(ME and Allied courses only)** 5.1:Measures of central Tendency -mean, median, mode for ungrouped & grouped data 5.2:Measures of dispersion –Range, mean deviation, standard deviation, variance, coefficient of variation 5.3: Corrected mean and relation between standard deviation and mean.					**CO3**
5.Complex Numbers (electronics and Allied courses only) 5.1:Definition of complex number and Argand diagram, equality of complex numbers, 5.2:powers of 'i' ,complex conjugates,					

5.3:Addition& subtraction of complex nos. Multiplication& division of complex nos. 5.4: Modulus and argument of a complex number 5.5:Polar form & exponential form of complex no. 5.6: De Moivre's theorem., nth root of complex nos. 5.7:Hyperbolic, exponential, circular functions			
Total	**75**	**64**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY (GC201)

Unit No	**Unit**	**Number of lectures**	**Marks**
1	**Determinants & Matrices**	12	15
2	**Integration**	22	20
3	**Definite Integrals**	08	10
4	**Vectors**	12	15
5	**Statistics /Complex Number**	10	15
	Total	**64**	**75**

- Tutorial books should be maintained by students (5 marks)
- Two home assignments per semester (5 marks)

  The Two assignments each comprises of thirty questions which includes 15 short questions and fifteen long questions. First assignment will cover fifty percent of syllabus

  and second assignment will cover remaining portion of syllabus
- Topic-wise class assignment (15 marks)

  Class assignment comprises of ten short and ten long questions.

9. LEARNING RESOURCES

Text Books /reference books

S. No.	Title of Books	Author	Publishers
1	Mathematics for Polytechnic Students(Basic Mathematics)	S.P. Deshpande	Pune VidyarthiGrihaPrakashan 1786, Sadashiv Peth, Pune
2	Mathematics for Polytechnic Students(Engineering Mathematics)	S.P. Deshpande	Pune VidyarthiGrihaPrakashan 1786, Sadashiv Peth, Pune
3	Applied Mathematics	S.B. Gore, M.B.Patil, S.P. Pawar	Vrinda Publications

Reference Books for further study

S. No.	Title of Books	Author	Publishers
1	Applied Mathematics I	Dr. U.B.Jangam, K.P. Patil, Nalini Kumthekar	Nandu Printers& Publishers Pvt. Ltd. Mumbai
2	Applied Mathematics for Polytechnics	H.K. Dass	CBS Publishers & Distributers Pvt. Ltd. Pune
3	Advanced Engineering mathematics	H.K. Dass	S. Chand

(GC 202) APPLIED PHYSICS- II

1. COURSE OBJECTIVE:

On successful completion of the course, Students completing the Applied Physics II course will be able to demonstrate competency and understanding of the basic concepts found in, Electrostatics, Current Electricity, Electromagnetism and Electromagnetic Induction, Light and Optics and Sound, and will be able to utilize the knowledge to demonstrate competency with experimental methods that are used to discover and verify the concepts related to content knowledge.

2.TEACHING AND EXAMINATION SCHEME

Semester	**II**								
Course code & course title		**Periods/Week (in hours)**			**Total Hours**	**Examination Scheme**			
						Theory Marks		**Practical Marks**		**Total Marks**
(GC202) Applied Physics- II		**L**	**T**	**P**	**H**	**TH**	**TM**	**TW**	**PR/OR**	
		03	**0**	**02**	**80**	**75**	**25**	**25**	**-**	**125**

3. COURSE OUTCOMES:

GC202.CO1: Understand the Fundamental Concepts of Electrostatics, Current Electricity, Electromagnetism and Electromagnetic Induction, Light, Optics and Sound.
GC202.CO2: Explain the basic principles of Electrostatics, Current Electricity, Electromagnetism and Electro Magnetic Induction, Light , Optics and sound.
GC202.CO3: Apply the knowledge of Electrostatics, Current Electricity, Electromagnetism and Electromagnetic Induction, Light, Optics and Sound to specific applications.
GC202.CO4: Compute various parameters in the field of Electrostatics, Current Electricity, Electromagnetism and Electromagnetic Induction, Light, Optics and Sound.

4. Mapping Course Outcomes with Program Outcomes

Relationship : 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	**Problem Analysis**	**Design and Devlopment of Solutions**	**Engg. Tools, Experimentatn & Testing**	**Engg. Practices for Society,Sustain ability& Environment**	**Project Management**	**Life -long Learning**
CO 1	3	3	1	1	2	0	3
CO 2	3	3	1	1	2	0	2
CO 3	3	2	3	3	3	1	1
CO 4	2	2	2	3	1	1	1

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks | **Thr = Teaching hours** | **CO = Course Objectives**			
Unit	**M**	**Thr**	**CO**
1 UNIT NAME: ELECTROSTATICS	**12**	**8**	**CO1, CO2, CO3, CO4**
1.1 Coulomb's law, Electric field,			
1.2 Electric field Intensity, Electric lines of force and properties			
1.3 Electric potential, Definition of Absolute potential			
1.4, Potential difference, Potential of sphere,			
1.5 Potential of earth.			
1.6 Capacitance,			
1.7 Capacitors in Parallel Derivation of Expression			
1.8. Capacitor in series Derivation Of Expression			
2. UNIT NAME: CURRENT ELECTRICITY	**20**	**12**	**CO1, CO2, CO3, CO4**
2.1 Definition of Electric Current and its Unit, Ohm's Law, Resistance,			
2.2 Factors on which resistance depends, Specific resistance. Effect of temperature on resistance Temperature coefficient of resistance,			
2.3 Resistances in Series and parallel			
2.4 EMF and Internal resistance of cell			
2.5 General Equation of ohm's law.			
2.6. Wheatstone's Network and Principle of Meter Bridge			
2.7 Principle of Potentiometer (Vα L) and Applications to compare EMF of given cells by single cell method and sum difference method			
2.8 Determination of Internal resistance of a cell using potentiometer.			
2.9 Electric Power and Electric Energy, KWh			
2.10 Calculation of Energy bills			
2.11 Heating Effect of Electric current. Joule's law.			
2.12 Applications in house hold appliances			
3. **UNIT NAME: ELECTROMAGNETISM AND EM INDUCTION**	**16**	**10**	**CO1, CO2, CO3, CO4**
3.1 Magnet, Magnetic field, Magnetic flux, and magnetic flux density and its unit			
3.2 Magnetic effect of Current, Oersted's Experiment, Right hand Thumb Rule, Biot Savart law			
3.3 Magnetic field at the center of the coil (no derivation), Magnetic field due to coil (Qualitative discussion only			
3.4 Electromagnet. Force acting on a current carrying conductor placed in magnetic field and expression (no derivation)			
3.5 Fleming's left-hand rule. Electromagnetic Induction. Faraday's Experiment			
3.6. Faraday's laws Lenz's law. Self-Induction and Mutual Induction.			
3.7 Transformer Principle.			
3.8 Step up and Step-down transformer.			
3.9 Induction Heating			
3.10 Induction heater and uses			
4. **UNIT NAME: LIGHT AND OPTICS**	**16**	**10**	**CO1, CO2, CO3, CO4**
4.1 Frequency Range of Infrared, ultraviolet and visible light and their uses			
4.2 Reflection, Refraction, Snell's law, refractive index.			
4.3 Refraction through glass slab and prism.			
4.4 Total Internal reflection applications in optical fibers.			
4.5 Advantages of optical fibers. LASER, sources and applications.			

4.6. Luminous Intensity, Intensity of Illumination			
4.7 Inverse square law of Illumination (No derivation)			
4.8 Principle of Photometry, X rays,			
4.9 Production of X Rays by Coolidge tube			
4.10 Properties and applications			
5. **UNIT NAME: SOUND**	**11**	**08**	**CO1, CO2, CO3, CO4**
5.1 Sound as longitudinal wave,wavelength,frequency,time period, amplitude,			
5.2 Free vibration force vibration,resonance, examples,			
5.3 Echo reverberation ,pitch loudeness,intensity of sound,			
5.4 Ultrasonic waves, Piezo electric effect, Principle of Production of ultra-sonics waves			
5.5 Application of Ultra sonics in finding depth of sea,			
5.6. Detection of flaws in metal, soldering, Drilling,			
5.7 Ultrasonic Cleaning			
5.8Ultrasound for medical purposes.(Just Uses)			

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	Number of lectures	Marks
1	ELECTROSTATICS	8	12
2	CURRENT ELECTRICITY	12	20
3	ELECTROMAGNETISM AND EM INDUCTION	10	16
4	LIGHT AND OPTICS	10	16
5	SOUND	8	11
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS

No	Practicals	Marks
1.	Specific Resistance by Ammeter Voltmeter Method	25
2	Specific Resistance by Meter Bridge Method	25
3	To Verify the Series Law of Resistance by Meter Bridge Method	25
4	To Verify the Parallel Law of Resistance by Meter Bridge Method	25
5	To Compare the emf of two cells by single cell method	25
6	To find the internal resistance of a cell by Potentiometer Method	25
7	To find the velocity of sound by Resonance Tube method	25
8	To find the Refractive index	25
	Total (Average)	25

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	B G Dhande	Applied Physics of Polytechnics	Pune Vidyarthi Griha Prakashan
2	Bhandarkar	Applied Physics of Polytechnics	Vrinda publication
3	R K Gaur and S L Gupta	Engineering Physics	Dhanpat Rai & Sons Delhi
4	Dr. Vasudev R Bhagwat	A Text Book of Applied Physics for Polytechnics	Broadway Publishing House
5	B L Thereja	Engineering Technology	S. Chand

Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	Halliday D and Resnick	Physics Part I-II	Wiley Eastern Ltd.
2	Satish k. Gupta	ABC of Physics I&II	Modern Publisher
3	Saxena HC and Singh Prabhakar	Applied Physics Vol I & II	S. Chand Publisher

(GC203) ENVIRONMENTAL STUDIES

1. COURSE OBJECTIVE:

Environment is the nurturing force upon which we depend. It decides our well being, our health & quality of our life. The environment is deteriorating at an alarming rate due to increasing human activity and can be saved only by timely human action. The aim of Environmental studies is to sensitize the students towards the need to conserve & protect natural resources & biological support systems. With the aim to develop an attitude of concern for the environment the students will learn to choose environmentally friendly options for sustainable development and live in harmony with nature.

2. TEACHING AND EXAMINATION SCHEME :

Semester	**I**								
Course code & course title		**Periods/Week (in hours)**			**Total Credits**	**Examination Scheme**			
						Theory Marks		**Practical Marks**		**Total Marks**
(GC203) Environmental Studies		**L**	**T**	**P**	**H**	**TH**	**TM**	**TW**	**PR/OR**	
		04	**-**	**-**	**64**	**75**	**25**	**-**	**-**	**100**

3. COURSE OUTCOMES:

GC203.CO1: Understand the role and importance of various elements of Environment.

GC203.CO2: Identify the concerns related to the natural resources, ecosystems, biodiversity, pollution and social issues of environment.

GC203.CO3: Develop sensitivity towards Environmental issues.

GC203.CO4: Co-relate causes affecting the environment & biodiversity.

4. Mapping Course Outcomes with Program Outcomes :

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Devlopment of Solutions	Engg. Tools, Experimentation	Engg. Practices for Society,Sustainability	Project Management	Life -long Learning
CO1	2	1	1	0	3	2	2
CO2	2	1	1	0	3	2	2
CO3	1	1	1	0	3	2	2
CO4	1	1	2	0	3	2	2

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks | **Thr = Teaching hours** | **CO = Course Objectives**			
Unit	**Mks**	**Thr**	**CO1, CO3, CO4**
UNIT 1.0 : Multidisciplinary Nature of Environmental Studies	**09**	**08**	
1.1 Environmental studies : Definition , Scope and Importance			
1.2 Need for Public Awareness			
1.3 Environment & Human Health			
1.4 Environmental Ethics			
1.5 Value Education			
1.6 From Unsustainable to Sustainable Development : Concept and Guidelines			
1.7 Concept of Environmental Audit (EA) Environment Impact Assessment (EIA)			
1.8 Ecological Foot Prints			
UNIT 2.0 : ECOSYSTEM AND BIODIVERSITY	**15**	**13**	**CO1, CO2, CO3, CO4**
2.1 Ecosystem 2.1.1Concept, Structure & functions of ecosystem (Function of producer, consumer and decomposer) 2.1.2 Food chain & Food web- Concept & Examples 2.1.3 Energy flow in Ecosystem 2.1.4 Ecological Pyramids (Inverted & Upright) Pyramid of Number, Biomass & Energy. 2.1.5 Ecological Succession (Primary & Secondary Succession) 2.1.6 Study of Ecosystem: characteristic features structure and functions) Terrestrial(Forest, Grassland, Desert) Aquatic(Pond, River & Ocean)			
2.2 Biodiversity 2.2.1 Definition of Biodiversity 2.2.2. Types of Diversity (Genetic, Species & Ecosystem) 2.2.3. Value of Biodiversity (Consumptive , Productive, Social ,Aesthetic Moral & Optional value) 2.2.4 India as a Mega- diversity Nation 2.2.5 Biogeographical classification of India 2.2.6 Extinct, Endangered, Threatened & Endemic Species -Examples (of India) 2.2.7 Threats to Biodiversity (Habitat loss, Poaching of Wild life & Man Wildlife Conflict) 2.2.8 Reasons for loss of Biodiversity 2.2.9 Conservation of Biodiversity (Insitu & Exsitu conservation)			
UNIT 3.0 : NATURAL RESOURCES	**18**	**15**	**CO1, CO2, CO3, CO4**
3.1 Forest Resource 3.1.1 Direct & Indirect value of Forest 3.1.2 Deforestation-causes & effects 3.1.3 Forest Management **3.2** Water Resource 3.2.1 Water as a scarce Resourc 3.2.2Use and over exploitation of surface and ground water 3.2.3 Need for Water Conservation 3.2.4 Construction of dams- Benefits and draw backs			

(Rehabilitation & Resettlement of people) 3.2.5 Rain water Harvesting. 3.2.6 Watershed Management 3.2.7 Conflicts over water in India **3.3** Energy Resource 3.3.1 Renewable & Non-Renewable sources of Energy 3.3.2 Growing Energy Needs. 3.3.3 Alternate Source of Energy (Solar ,Wind, Bio, Geothermal, Hydro & Nuclear Energy)			
3.4 Food Resource 3.4.1 Sources of Food 3.4.2 World Food Problems (Undernourishment & Malnourishment) 3.4.3 Changes caused by agriculture & overgrazing 3.4.5 Effects of modern agriculture on environment (use of synthetic fertilizers & synthetic pesticides in agriculture) **3.5** Mineral Resource 3.5.1 Types of Minerals 3.5.2 Use & Overexploitation of Minerals 3.5.3 Environmental Impact of Mining. **3.6** Land Resource 3.6.1 Pattern of Land Utilization (In India and World) 3.6.2 Land Degradation – Causes & Control Measures			
UNIT 4.0 : ENVIRONMENTAL POLLUTION- Sources , Effects & Control Measures	**24**	**20**	
4.1 Air Pollution 4.1.1 Definition, sources of air pollution(Primary and Secondary air pollutants with examples) 4.1.2 Effects on human health, animals, plants & Materials 4.1.3 Control of Air Pollution. 4.1.4 Removal of Particulate matter 4.1.5 Principles & Application of Control Equipments (Gravity and Inertial Separators, Cyclones, Filters, Electrostatic precipitators, Wet scrubbers) 4.1.6 Removal of Gaseous Pollutants (Combustion, Adsorption, Absorption) 4.1.7 Global Issues Definition, Cause & effects of Green House effect & Global Warming. Ozone layer Depletion, Acid Rain.			**CO1, CO2, CO3, CO4**
4.6 Noise Pollution :- 4.6.1 Definition. 4.6.2 Sources of Noise Pollution 4.6.3 Effects of Noise Pollution on Human health (Noise Induced hearing loss, Physiological & Psychological Effects) 4.6.4 Control of Noise Pollution.			
4.7. Nuclear Pollution / Radioactive Pollution:-			

4.7.1 Definition 4.7.2. Sources of nuclear Pollution (Natural & Man made) 4.7.3. Effects of Nuclear Pollution 4.7.4. Control of Nuclear Pollution 4.7.5.Disposal of Nuclear waste (Low, Medium & High activity waste) 4.7.6 Nuclear Accidents & Holocaust – case study			
4.8 Solid Waste Pollution. Definition: Refuse, Garbage Sources of Solid waste Types of solid waste (MSW, HW, BMW & EW) Effects of Consumerism Segregation of Solid waste at source Treatment of MSW (Open dumping, Land filling, incineration & composting) Waste Utilization (Reuse, Reclaim & Recycle) Solid waste Management System – Flow sheet diagram **4.9** Role of an Individual in Prevention of Pollution.			
UNIT 5.0 : **SOCIAL ISSUES & ENVIRONMENT**	**09**	**08**	**CO2, CO3, CO4**
5.1 Environmental Legislation Article 47 & Article 51-A(g)of the constitution on Environment. 5.1.1 Protection Functions of Ministry of Environment and Forest Govt. of India Objectives & Functions of Central & state pollution Control Boards Environmental Protection Act. Air (Prevention & Control of Pollution) Act. Water (Preventation & Control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Motor vehicle Act.			
5.2 Social Issues 5.2.1Women & Child Welfare 5.2.2 Role of IT in Environment & Human Health 5.2.3 AIDS 5.2.4 Population Growth & Variation among Nations 5.2.5 Human Rights			

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	Number of lectures	Marks
1	**MULTI-DISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES**	08	09
2	**ECOSYSTEM AND BIODIVERSITY**	13	15

3	**NATURAL RESOURCES**	15	18
4	**ENVIRONMENTAL POLLUTION**	20	24
5	**SOCIAL ISSUES & ENVIRONMENT**	08	09
	Total	64	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	Erach Bharucha	Textbook of Environmental Studies	Universities Press (India) Private Ltd.
2	Dr. Suresh K. Dhameja	Environmental studies	S.K. Kataria & Sons
3	Y. Anjaneyulu	Introduction to Environmental Science	B.S Publications
4	S. Deswal & A. Deswal	A Basic Cource in Environmental Studies	Dhanpat Rai & Co.
5	P. Meenakshi	Elements of Environmental Science and Engineering	Prentice Hall of India (PHI)

Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	Pandya and Camy	Environmental Engineering	Tata McGraw Hill
2	Asthana D.K. and Asthana Meera	Environmental Problems and Solutions	S. Chand & Co.
3	Gilbert M. Masters	Introduction to Environmental Engineering and Science.	Prentice Hall of India (PHI)
4.	M N Rao & HVN Rao	Air Pollution	Tata McGraw Hill

FIELD ACTIVITIES (OPTIONAL)

1. Visit to Selaulim/ Anjunem Dam.
2. Visit to show Hill cuttings, mining areas.
3. Visit to show Rain water harvesting project / Vermicomposting plant / watershed management project. (Krishi Vigyan Kendra – Old Goa)
4. Visit to Garbage treatment plant.

***On Completion of visit Report to be submitted.**

(GC204) ENGINEERING DRAWING

1. Course Objective: Drawing is a graphical language of engineering field. Engineering technician irrespective of his/her field of operation in an industry is expected to possess a thorough understanding of drawing, which includes visualization of objects and the proficiency in reading and interpreting a wide variety of engineering drawings. It is the skill, which translates an engineering idea into lines and dimensions. Besides this he/she is also expected to possess a certain degree of drafting skills- depending upon his/her job.

2. **TEACHING AND EXAMINATION SCHEME:**

Course Code & Course Title	**Periods/ Week (In Hours)**			**Total Hours**	**Examination Scheme**				
					Theory Marks		**Practical Marks**		**Total Marks**
(GC204)	**L**	**T**	**P**	**H**	**TH**	**TM**	**TW**	**PR/OR**	
Engineering Drawing	-	-	5	80	-	-	50	50	**100**

3. Course Outcomes:

On successful completion of the course the student will be able to:
GC204.CO1: Understand different methods of projection, sectioning of solids and development of surfaces.
GC204.CO2: Select the relevant procedural methods for preparing Engineering Drawing.
GC204.CO3: Draw Isometric views and orthographic projection of full and sectioned objects and development of surfaces
GC204.CO4: Examine and Interpret Engineering Drawings

4. Mapping Course Outcomes with Program Outcomes

Relationship- 1:Slight (low) 2:Moderate(Medium) 3: Substantial(High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
	Basic and discipline specific knowledge	Problem analysis	Design & development of solution	Engg tools exptn and & testing	Engg Practice for society,sustainability and environment	Project management	Lifelong learning
CO1	3	2	1	3	1	1	1
CO2	3	1	2	3	1	2	2
CO3	2	2	2	3	1	2	2
CO4	2	2	2	2	1	2	3

5. Detailed course Contents/ Micro lesson plan

M=Marks Prhr= Teaching Hrs CO=Course Outcomes

Unit	Mark	Prhr	CO
1. Introduction 1.1 Importance of engineering drawing as a means of communication. 1.2 Planning of drawing sheet as per SP 46(latest revision) 1.3 Indian standard practices of laying out and folding of drawing 1.4 Different types of lines used in engineering drawing. 1.5 Importance of scale in Engineering Drawings. 1.6 Lettering 1.7 Methods of dimensioning, Dimensioning terms and notation -use of SP 46(latest revision), General rules for dimensioning, Dimensioning of cylinder, holes, arcs of circle, narrow space, angles, countersunk hole, taper.	05	05	CO2
2. Geometrical construction & Engineering Curves 2.1Construction of an Equilateral and Isosceles triangle, Square, Regular pentagon & Regular hexagon given length of a side using general method of construction 2.2Construction of Engineering curves like: Ellipse- by focus & directrix method and arcs of circles method Parabola- by focus & directrix method and rectangle method Hyperbola- Focus and directrix method 2.3 Cycloid- by generating circle rolling on a straight line 2.4 Involutes of a circle. 2.5 Draw normal & tangents to the above curves from given point on the curve Curves to be explained with the help of applications.	05	15	CO2
3. Orthographic projection 3.1 Definitions of various terms associated with orthographic projections. Planes of projections. Concept of Quadrants. 3.2 First and third angle method of projection. 3.3 Projection of points 3.4Projection of lines Parallel to both Principal planes Parallel to one and Perpendicular to other Principal plane.	18	30	CO1, CO2, CO3, CO4

Inclined to one plane and parallel to other plane. 3.5 Projection of planes:Triangle, Square, circle when inclined to one principal plane & perpendicular to other plane. 3.6 Projection of solids: Cylinder, cone. Right regular solids such as (i) Prism: Square& Pentagonal (ii) Pyramid: Triangular & Square. Projections of above mentioned solids when axis is inclined to one principal plane & Parallel to other principal plane. 3.7 Conversion of simple pictorial views into orthographic views. *Problems where one end of the line is in one quadrant & other end in other quadrant and traces are to be excluded.* *Problems where apparent shape of plane are given, true shape & slope angle are to be drawn are excluded.*			
4. Section of solids Development of lateral surfaces **4.1** Concept of sectioning planes, Auxiliary planes and true shape of section. 4.2 Drawing section of solids like square prism, square pyramid, cylinder and cone with sectioning plane inclined to one principal plane and Perpendicular to the other principal plane (Axis of solid perpendicular to one principal plane and parallel to the other) 4.3Concept and importance of surface development in the engineering field. Methods of development of surfaces-Radial & Parallel line method. Development of surfaces for solids like square prism, square pyramid, cylinder and cone. *Development of solids standing on its base & cut by a plane inclined to HP and perpendicular to VP is also included.*	10	15	CO1, CO3
5. Isometric Views 5.1Difference between Isometric projection & Isometric view. 5.2Isometric view of geometrical planes and solids. 5.3Conversion of orthographic views into isometric views. 5.4Construction of Isometric view for any real object.	12	15	CO3, CO4
Total	50	80	

6. Course Delivery:

The course will be delivered through Practicals, class room interaction and exercises.

7. Specification table for Practical/Macro Lesson Plan

Unit No.	Unit	No. Of Practical Hrs.	Marks
1	Introduction	05	05
2	Geometrical construction & Engineering Curves	15	05
3	Orthographic projection	30	18
4	Section of solids Development of lateral surfaces	15	10
5	Isometric Views	15	12
	Total	**80**	**50**

8. Specification table for Practical/ Termwork:

No.	Practical
1	TYPES OF LINES, LETTERING, DIMENSIONING.
2	GEOMETRICAL CONSTRUCTIONS
3	ENGINEERING CURVES
4	PROJECTION OF POINTS & LINES
5	PROJECTION OF PLANES
6	PROJECTIONS OF SOLIDS
7	ORTHOGRAPHIC PROJECTIONS (First angle)
8	ORTHOGRAPHIC PROJECTIONS(Third angle)
9	SECTIONS AND DEVELOPMENT OF SOLIDS
10	ISOMETRIC VIEWS

9. Learning Resources:

Text Books

S.No.	Author	Title	Publisher
1	N.D. Bhatt	Engineering Drawing	Charoter Publisher,Anand
2.	R. K. Dhawan	Engineering Drawing	S. Chand Publishing
3.	K.R. Gopalakrishna	Engineering Drawing	Subhas Publications.

Reference Books only for further study

S.No.	Author	Title	Publisher
1	P.S. Gill	Geometrical Drawing	Kataria & Sons
2	P.S. Gill	Machine Drawing	Kataria & Sons
3	N.D. Bhatt	Machine Drawing	Charoter Publisher,Anand

Indian and International codes needed

S.No.	Author	Title	Publisher
1.	BIS, India	SP 46. (Latest revision).	BIS, India

(GC205) ENGINEERING MATERIALS

1. COURSE OBJECTIVE:

This course is introduced with an objective of providing knowledge to students regarding properties and composition of materials for engineering applications and enabling them to make comparative study of materials while selecting the appropriate material for various engineering applications.

2. TEACHING AND EXAMINATION SCHEME

Semester	II								
Course code & course title		Periods/Week (in hours)			Total Hours	Examination Scheme			
						Theory Marks		Practical Marks		Total Marks
		L	T	P	H	TH	TM	TW	PR/OR	
(GC205) ENGINEERING MATERIALS		3	--	--	48	75	25	--	--	100

3.COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

GC205.CO1: List out the properties of materials used in engineering applications.

GC205.CO2: Explain the composition and properties of various engineering materials.

GC205.CO3: Classify materials based on composition and properties.

GC205.CO4: Select the appropriate material/s for the given engineering application/s.

4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Devlopment of Solutions	Engg. Tools, Experimentatn & Testing	Engg. Practices for Society,Sustain ability & Environment	Project Management	Life -long Learning
CO1	3	2	0	0	0	0	1
CO2	3	2	1	0	0	0	1
CO3	2	2	2	1	1	0	1
CO4	2	3	3	2	1	0	1

Relationship : Low-1 Medium-2 High-3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	**Thr = Teaching hours**	**CO = Course Objectives**			
Unit			**M**	**Thr**	**CO**
1 INTRODUCTION TO ENGINEERING MATERIALS			**08**	**04**	
1.1 Classification of Materials: Metal and Non-metal, Ferrous Metal & Non-ferrous Metals, Differences between Metals & Non-metals					**CO1, CO2, CO3, CO4**
1.2 Properties of Materials:(Note: Properties to be explained with relevant examples.) 1.2.1 Physical properties – Melting point, Freezing point, Boiling point, Density, Linear co-efficient of expansion, Thermal conductivity, Electrical resistivity					
1.2.2 Mechanical properties – Strength, Elasticity, Plasticity, Ductility, Malleability, Toughness, Brittleness, Hardness, Fatigue, Creep.					
1.2.3 Electrical properties – Resistivity, Conductivity, Temperature coefficient of resistance, Dielectric strength, Thermo-electricity, Super conductivity					
1.2.4 Magnetic properties – Permeability and Coercive force					
1.2.5 Chemical properties - Corrosion resistance and Chemical composition					
2 FERROUS & NON-FERROUS METALS & ITS ALLOYS			**18**	**12**	
2.1 FERROUS ALLOYS: 1.1.1 Low carbon steel, Medium carbon steel, High carbon steel, their carbon percentage, properties & uses. 1.1.2 Cast iron: grey cast iron, white cast iron, their properties & uses 1.1.3 Alloy steels: Constituents of alloy steels such as Phosphorous, Sulphur, Silicon, Manganese and their effect on properties of materials. 1.1.4 Stainless steel, Nickel-chromium-molybdenum steel, its properties & uses. 1.1.5 Tool steel – composition, HSS, properties & uses					**CO1, CO2, CO3, CO4**
2.2 NON-FERROUS METALS & ALLOYS: 2.2.1 Aluminium – Properties & uses 2.2.2 Aluminium alloys – constituents of alloy & their effect on properties of metal 2.2.3 Properties & uses of Duralumin, Y-alloy and Al-Si alloy 2.2.4 Copper – Properties & uses. 2.2.5 Copper alloys – Constituents of alloy & their effect on properties of metal 2.2.6 Properties & uses of Copper – Zinc alloys such as Muntz metal, manganese, bronze, Copper-Tin alloys such as Bronze, Copper-Aluminium alloys such as Aluminium bronzes. 2.2.7 Lead and its hazard to the environment					**CO1, CO2, CO3, CO4**
3 NON-METALLIC MATERIALS			**18**	**10**	
3.1 CONSTRUCTION MATERIALS 3.1.1 Classification of rocks, common building stones and their applications. 3.1.2 Cement: Types of cement, composition and applications 3.1.3 Bricks: Composition, properties, Classification, Special bricks- Refractory and fly-ash bricks and uses 3.1.4 Clay: Types, products of clay- tiles and pipes 3.1.5 Sand- sources – river, crushed aggregates, applications					**CO1, CO2, CO3, CO4**
3.2 ENGINEERING CERAMICS 3.2.1 Refractories: Desirable properties, Properties and Applications of Fire clay and Silica Refractory, Difference between acid, basic & neutral refractories					**CO1, CO2, CO3,**

3.2.2 Glass: Properties & uses of soda glass, borosilicate glass and fibre glass 3.2.3 Glass wool: Composition, properties & uses 3.2.4 Timber: Common varieties of timber, uses of wood products, veneer and plywood 3.2.5 Natural & Synthetic abrasive materials: Introduction, Properties & uses			**CO4**
4 CONDUCTOR, SEMI -CONDUCTOR, AND INSULATING MATERIALS	**16**	**12**	**CO1, CO2, CO3, CO4**
4.1 Classification of Materials as Conductor, Semiconductor and Insulating materials			
4.2 Conductor Material: 4.2.1 High conductivity materials: Copper, Aluminium, Carbon, Silver, Lead & Tungsten, their properties as conducting materials and applications. 4.2.2 High resistivity materials: nichrome, constantan, manganin and their applications			
4.3 Insulating Materials: Introduction and Characteristics of Good Insulating materials 4.3.1 Solid Insulating materials- wood, paper, rubber, mica, glass fibre, porcelain, PVC, resins, their characteristics as insulating materials and applications			
4.4 Semiconductor Materials: Silicon & Germanium, their specifications as semiconductor material and uses.			
Unit 5 MAGNETIC & COMPOSITE MATERIALS	**15**	**10**	
5.1 Magnetic Materials: Classification as Diamagnetic, Paramagnetic, Ferromagnetic, List of these materials and their applications			**CO1, CO2, CO3, CO4**
5.2 Composite Materials**:** metal matrix, ceramic matrix and polymer matrix composites, types of reinforcement materials and their applications			
5.3 Paints & Lubricants: 5.3.1 Classification: oil based and polymer based paints 5.3.2 Constituents of Paints – resin, binder, pigment, additives, solvents 5.3.3 Lubricants – Functions of lubricants, Types of Lubricants**,** Composition and Applications			
Total	**75**	**48**	

6. COURSE DELIVERY:

The Course will be delivered through lectures and class room interactions

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	**Unit Name**	**Number of lectures (hrs)**	**Marks**
1	Introduction to Engineering Materials	04	08
2	Ferrous & Non-Ferrous Metals & its alloys	12	18
3	Non-Metallic Materials	10	18
4	Conductor, Semi-Conductor, & Insulating Materials	12	16
5	Magnetic & Composite Materials	10	15
		48	**75**

8. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	R.S. Khurmi	Material Science	S. Chand
2	R. Srinivasan	Engineering Materials & Metallurgy	Tata McGraw Hill
3	TTTI Madras	Electrical Engineering Materials	McGraw Hill Education, 2004
4	S. K. Hajra Choudhury	Material Science and Processes	Indian book distribution
5	P. C. Varghese	Building Materials	PHI
6	J. B. Gupta	Electrical and Electronic Engineering Materials	Katson

SEMESTER III

(EL 301) CIRCUIT THEORY

1. COURSE OBJECTIVES:

This course will enable students to understand the concepts and principles of electrical circuit and their analysis. It will also enable the students to understand the concept of resonance and various properties of resonant circuit.

2. TEACHING AND EXAMINATION SCHEME

Semester	**III**								
Course code & course title		**Periods/Week (in hours)**			**Total Hours**	**Examination Scheme**			
						Theory Marks		**Practical Marks**	**Total Marks**
(EL301) Circuit Theory		**L**	**T**	**P**	**H**	**TH**	**TM**	**TW**	**PR/OR**	
		3	-	2	5	75	25	25	-	125

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

EL301.CO1: Explain the theorems applicable for electrical circuits, terms related to AC circuits and resonance.
EL301.CO2: Apply the theorems for solving and simplifying an electrical circuit.
EL301.CO3: Analyze the various electrical circuits
EL301.CO4: Evaluate the various circuit parameters and performance of an electrical circuit.

4. MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation& Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
EL301.CO1	3	1	1	1	-	1	2
EL301.CO2	3	3	3	3	1	2	3
EL301.CO3	3	3	3	3	2	3	3
EL301.CO4	3	3	3	3	3	3	2

Relationship : Low-1 Medium-2 High-3

	PSO1	PSO2
EL301.CO1	1	-
EL301.CO2	3	1
EL301.CO3	3	3
EL301.CO4	3	2

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	**Thr = Teaching hours**	**CO = Course Objectives**			
Unit			**M**	**Thr**	**CO**
1. D.C.NETWORK THEOREMS			**24**	**15**	**CO1,CO2, CO3,CO4**
1.1 Definition: Circuit parameters, Linear, non-linear, bilateral, unilateral, electric network, passive and active network, node, branch, loop/mesh. Ideal and practical voltage and current sources, source transformation. Kirchhoff's current law, Kirchhoff's voltage law. Series and parallel connection of resistors. Voltage and current divider theorem. Star to delta and delta to star conversions					
1.2 Mesh analysis & nodal analysis with current and voltage sources. Superposition theorem, Thevenin's theorem, Norton's theorems, Maximum power transfer theorem.					
2. SINGLE PHASE AC. CIRCUITS			**21**	**15**	**CO1,CO3, CO4**
2.1 AC waveform and definition of various terms associated with it. AC through pure resistance, pure inductance, pure capacitance. Vector representation of alternating quantity					
2.2 Concept of reactance, impedance. Voltage triangle, impedance triangle, power triangle - definition of power factor, active , reactive, apparent power. Analysis of single phase circuits – RL, RC and RLC (vector method analysis.) Analysis of parallel RLC circuits – (Only admittance method, application of admittance)					
3 RESONANCE			**12**	**06**	**CO1,CO3, CO4**
3.1 Concept of resonance in circuit, Definition of resonant frequency, Q factor, bandwidth. Graphical representation.					
3.2 Calculation of resonant frequency, Q factor (selectivity) and bandwidth for series & parallel resonant circuit (no derivation).					
4 POLY PHASE CIRCUIT			**12**	**09**	**CO1,CO3, CO4**
4.1 Generation of poly phase voltage, phase sequence, interconnection of three phases (star & delta connection), Relationship between phase and line current and line & phase voltage for star and delta connected balanced loads.					
4.2 Calculation of active, reactive & apparent power.					
5 SYMMETRICAL COMPONENTS			**06**	**03**	**CO1,CO3, CO4**
5.1 Definition of unbalanced system (Positive, negative & zero sequence component) only. analytical method of evaluation of components					
Total			**75**	**48**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	Number of lectures	Marks
1	D.C.NETWORK THEOREMS	15	24
2	SINGLE PHASE AC. CIRCUITS	15	21
3	RESONANCE	06	12
4	POLY PHASE CIRCUIT	09	12
5	SYMMETRICAL COMPONENTS	03	06
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK

No	Practical (Minimum Eight)	Marks
1.	Verification of Kirchoff's law in d. c. circuit.	
2.	Verification of Thevenin's Theorem in d. c. circuit	
3.	Verification of Superposition theorem	
4.	Measurement of voltage & current in a series RL circuit and determine total voltage, impedance, reactance, inductance and resistance	
5.	Study of effect of addition of capacitance in R-L circuit on current & p. f.	
6.	Study of relationship between line & phase quantities in star and delta connected network	
7.	Determination of resistance & inductance of a given R-L load by measurement of voltage, current and p. f.	
8.	Connection and measurement of current drawn, power consumed and voltage drop in each element of a 2 branch parallel circuit.	
9.	Design assembly and testing of a series resonant circuit.	
10.	To plot charging & discharging curve of R-C circuit.	
	Total	25

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	B. L. Theraja	Electrical Technology Vol. I	S. Chand
2	Soni, Gupta	A Course in Electrical Circuit	Dhanpat Rai & Sons
3	Vincent Deltero	Principles of Electrical Engg.	Prentice Hall of India

(EL302) ELECTRICAL MACHINES I

1. COURSE OBJECTIVES:

This subject enables the student to understand the working principle, construction, performance, control and applications of electrical machines such as DC Generator, DC motor & Transformers. The students get familiarized with the classification & operation of these machines.

2. TEACHING AND EXAMINATION SCHEME

Semester	**III**								
Course code & course title		**Periods/Week (in hours)**			**Total Hours**	**Examination Scheme**			
						Theory Marks		**Practical Marks**		**Total Marks**
(EL302) Electrical Machines I		L	T	P	H	TH	TM	TW	PR/OR	
		4	-	2	6	75	25	25	-	125

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

EL302.CO1: Explain construction, operation and classification of DC machines and transformers
EL302.CO2: Demonstrate starting and speed control methods of DC motors, parallel operation and testing methods for transformers
EL302.CO3: Categorize losses in DC machines and Transformers and analyze performance of transformers
EL302.CO4: Determine voltage regulation and efficiency of Transformer using suitable method.

4. MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation & Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
EL302.CO1	2	-	2	3	-	3	2
EL302.CO2	2	2	2	3	2	3	2
EL302.CO3	3	3	-	3	-	3	3
EL302.CO4	3	3	1	3	3	3	3

Relationship : Low-1 Medium-2 High-3

	PSO1	PSO2
EL302.CO1	2	-
EL302.CO2	2	2
EL302.CO3	1	1
EL302.CO4	1	1

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	**Thr = Teaching hours**	**CO = Course Objectives**		
Unit			**M**	**Thr**	**CO**
1 DC GENERATOR			**15**	**13**	**CO1,CO2, CO3**
1.1 Construction and working of a simple loop DC Generator (including action of split ring and brushes) Constructional details and material used for parts (yoke, pole-core, pole shoe, field winding, armature core, armature winding, commutator, brushes) & their functions, lap and wave winding-basic diagram and comparison Definitions: back pitch, front pitch, pole pitch, resultant pitch and commutator pitch Expression for generated EMF (no derivation) & factors on which it depends					
1.2 Classification of DC generators w. r. t i) Excitation system ii) connection of field & armature winding. Voltage & power equations of these various types. Process and necessary conditions for voltage build up in DC Shunt generator Losses and types of efficiencies					
2 DC MOTORS			**15**	**13**	**CO 1, CO2**
2.1 Principle of operation, concept of back emf & its importance, Development of torque and types of torques in a motor. Classification of DC motors based on connection of field & armature winding, their voltage & power equations.					
2.2 Speed equation & factors on which speed depends methods of speed control (DC shunt-armature control, field control, ward leonard control) (DC series- armature control (armature diverter), field control(all methods) & voltage control) methods and their comparison. Characteristics of DC shunt, series & cumulative compound motors: 1. speed v/s armature current 2. torque v/s armature current 3. speed v/s torque, Applications of the various types of DC motors. Starting of DC motors – Necessity of a starter, three point & four point starters (diagram & working) Construction and working of brushless DC motor					

3 WORKING & CONSTRUCTION OF TRANSFORMERS	**15**	**13**	**CO1, CO3**
3.1 Definition and working principle of a transformer, Concept of ideal & practical transformer. Terms related to transformer: primary & secondary, H.V & L.V, step up, & step down . Construction: Simple diagram of transformer and labelling of parts List & functions of: core, windings, conservator, breather, buchholz relay, explosion vent, bushings Concept of leakage flux and its importance Concept & comparison of core type & shell type transformers (with diagrams), Various types of insulation used in transformers: inter turn, winding to winding, winding to core.			
3.2 Cooling system: necessity of cooling & brief description of different types of cooling methods Working & construction of tap changer: ON load & OFF load tap changer EMF equation of a transformer (No Derivation) Transformation ratio-voltage ratio, current ratio & turns ratio (numerical)			
4 PERFORMANCE & PARALLEL OPERATION OF TRANSFORMERS	**21**	**19**	**CO1, CO2, CO3, CO4**
4.1 Operation: No load and on load operation of a transformer with phasor Diagram (practical transformer for inductive load only). Final Equivalent circuit and transfer of its parameters referred to either side (numerical) Procedure of O.C & S.C test with diagrams (numerical).			
4.2 Performance : Concept & significance of voltage regulation, expression and calculation of approximate voltage regulation condition for minimum regulation.(no derivation) Losses and efficiency (calculation of commercial & all day efficiency) of a transformer			
4.3 Salient features of a power & distribution transformer (three phase). Conditions to be satisfied for parallel operation of transformers (Diagrams for single phase & three phase) and their connections			
5 AUTOTRANSFORMERS & SPECIAL TRANSFORMERS	**09**	**06**	**CO 1**
5.1 Construction & principle of operation of an autotransformer, its advantages & disadvantages over two winding transformer Special transformers (constructional features):welding transformer , High frequency transformer.			
Total	**75**	**64**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	Number of lectures	Marks
1	DC GENERATORS	13	15
2	DC MOTORS	13	15
3	WORKING & CONSTRUCTION OF TRANSFORMERS	13	15

4	PERFORMANCE & PARALLEL OPERATION OF TRANSFORMERS	19	21
5	AUTOTRANSFORMERS & SPECIAL TRANSFORMERS	6	9
	Total	64	75

8. SPECIFICATION TABLE FOR TERM WORK

No	Practical (Minimum 8)	Marks
1.	To plot the O.C characteristics of a DC shunt generator and find the value of critical field resistance	
2.	To plot the external characteristics of a DC shunt generator.	
3.	Speed control of a DC shunt motor above & below normal speed.	
4.	To plot the sped torque characteristics of a DC shunt generator.	
5.	Starting a DC shunt motor using a starter and reversal of direction of rotation.	
6.	To perform Swinburne's test on a DC shunt motor to determine the various losses and calculate efficiency as a DC motor & generator.	
7.	Study of DC welding generator	
8.	Insulation resistance, polarity, phasing out & ratio test on a three phase transformer.	
9.	O.C & S.C test on a three phase transformer and calculation of equivalent circuit parameters.	
10.	Parallel operation of two single phase transformers and observation of the load sharing.	
11.	To study direct load test on a three phase transformer and measurement of its voltage regulation.	
12.	To perform back to back test on a single phase transformer to determine losses and calculate efficiency and regulation.	
13.	To study a welding transformer w. r. t:- i)construction of core, ii) placement of windings, iii)current controller & iv) cooling system.	
	Total	25

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	BHEL	Transformers	Tata Mcgraw
2	S.K. Bhattacharya	Electrical machinery	Tata Mcgraw
3	J. B. Gupta.	Theory & performance of Electrical Machines	S. K. Kataria & sons
4	B. L. Theraja.	Electrical Technology (Vol II)	S Chand
5	P.S. Bhimbra.	Elementary theory of electrical machines	Khanna Publishers

(EL303) ELECTRICAL MEASUREMENTS & INSTRUMENTS

1. COURSE OBJECTIVES

This subject enables students to understand the basics of measurements and the construction, operation of various electrical measuring instruments. It also enables the students to know the selection and application of electrical measuring instruments for carrying out measurements.

2. TEACHING AND EXAMINATION SCHEME

Semester III									
Course Code & Course Title	**Periods/ Week (In Hours)**			**Total Hours**	**Examination Scheme**				
					Theory Marks		**Practical Marks**		**Total Marks**
(EL303) Electrical Measurements & Instruments	L	T	P	H	TH	TM	TW	PR/OR	
	3	-	2	5	75	25	25	25(P)	150

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

EL303.CO1: Explain qualities, errors, construction and working of electrical measuring instruments.
EL303.CO2: Apply suitable method of measurement and extend the range of measuring instruments.
EL303.CO3: Compare different electrical measuring instruments.
EL303.CO4: Select the appropriate measuring instrument for a given application.

4. MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation& Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
EL303.CO1	3	1	2	1	-	2	2
EL303.CO2	3	3	3	3	1	2	2
EL303.CO3	3	3	3	3	-	1	2
EL303.CO4	3	3	3	3	2	2	2

Relationship : Low-1 Medium-2 High-3

	PSO1	PSO2
EL303.CO1	2	2
EL303.CO2	2	2
EL303.CO3	2	1
EL303.CO4	3	2

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks | **Thr = Teaching hours** | **CO = Course Objectives**			
Unit	**M**	**Thr**	**CO**
1 FUNDAMENTALS AND PRINCIPLES OF MEASUREMENTS	**15**	**9**	**CO1, CO3, CO4**
1.1Need of measurement & significance of measurement. Qualities of instrument: sensitivity, accuracy, precision, reliability, reproducibility, drift, static error, true value, resolution. Classification of instruments: Absolute & secondary instruments, Indicating, recording & integrating instruments, Based on permissible limits of errors Errors: Gross error, Systematic error & Random errors			
1.2 Various effects of electric current and their use in measurement. Essentials of Indicating instruments: Deflecting torque, Control torque, Damping torque. Various methods of providing control torque & damping torque.			
2 AMMETER & VOLTMETER	**18**	**12**	**CO1, CO2, CO3, CO4**
2.1 Construction & Principle of operation of PMMC instrument, their advantages and disadvantages. Errors in PMMC type instruments. Construction & Principle of operation of moving iron type (attraction &repulsion type) instrument, their advantages and disadvantages. Errors in moving iron type instruments. Rectifier type instrument, its construction & advantages. Loading effect of Voltmeter.			
2.2 Extension of range of Ammeter and Voltmeter using Multiplier & Shunt, CT & PT.			
3 WATTMETER AND ENERGYMETER	**21**	**15**	**CO1, CO2, CO4**
3.1 Dynamometer type wattmeter: Construction & principle of operation Measurement of power: Three phase, 3 wire circuit by two wattmeter method, Phasor diagram, 3 phase, 4 wire circuits by 3 wattmeter method, Variation of wattmeter readings with load power factor. Errors in wattmeters and compensation. Extension of range of Wattmeter using CT and PT for single phase and three phase (using 2 wattmeter method).			
3.2 Induction type energy meter: Construction & principle of operation.(single phase) Extension of range of energymeter (single phase and three phase) using CT and PT. Concept & block diagram of Electronics energy meter.			
4. RESISTANCE MEASUREMENT	**9**	**6**	**CO1,CO2, CO3, CO4**
4.1 Classification of resistances Measurement of resistance by: Voltmeter Ammeter methods, Wheatstone's bridge method Circuit diagram and operation of Kelvin's Bridge, Kelvin's Double Bridge (No Derivation), Series type & shunt type ohm meter			
5 OTHER INSTRUMENTS	**12**	**6**	**CO1,CO4**

5.1 Construction, operation and applications of Power Factor meter: Electrodynamometer type (single phase) Construction, operation and applications of Frequency meter (Vibrating reed type), Phase sequence indicator (rotating type) Construction, operation and applications of Earth Tester and Meggar			
Total	**75**	**48**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	**Unit**	**Number of lectures**	**Marks**
1	FUNDAMENTALS AND PRINCIPLES OF MEASUREMENTS	9	15
2	AMMETER & VOLTMETER	12	18
3	WATTMETER AND ENERGYMETER	15	21
4	RESISTANCE MEASUREMENT	6	9
5	OTHER INSTRUMENTS	6	12
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK

Sr. No.	Practicals (Minimum eight)	Marks
1	Measurement of power by 3 ammeter method	
2	Measurement of power by 3 voltmeter method	
3	Measurement of resistance by Kelvin's Double Bridge	
4	Measurement of power in 3 phase 3 wire circuit by 2 wattmeter method	
5	Measurement of power in 3 phase 3 wire circuit by 1 wattmeter method	
6	Measurement of power in 3 phase 3 wire circuit by 3 phase wattmeter.	
7	Measurement of reactive power in 3 phase , 3 wire circuit by 1 wattmeter method	
8	Measurement of energy by energy meter	
9	Extension of range of Ammeter and Voltmeter using CT & PT	
10	Extension of range of wattmeter for measurement of power in 3 phase, 3 wire circuit by using CT & PT	
11	Measurement of power factor using power factor meter.	
12	Connection & measurement of voltage, current, power & energy using digital meters	
13	Connection & use of power analyzer	
	Total	25

9. LEARNING RESOURCES

Text Books

Sr No	AUTHOR	TITLE OF BOOKS	PUBLICATIONS
1	A. K. Sawhney	A course in Electrical & Electronic Measurements & Instrumentation	Dhanpat Rai & sons
2	S.C. Bhargava	Electrical Measuring Instruments & Measurements	B.S. Publication

Reference Books for further study

S. No.	Author	Title of Books	Publishers
1.	Vijay Singh	Fundamentals of Electrical & Electronic Measurements	New Age International(P) Ltd.
2.	N.V. Suryanarayana	Electrical Measurements & Measuring Instruments	Tata Mc Graw Hill

(EL304) GENERATION AND TRANSMISSION OF ELECTRICAL ENERGY

1. COURSE OBJECTIVES

The course content will enable the students to understand different sources of energy and generation of electricity from these sources. Students will also get acquainted with the components and performance assessment of transmission system.

2. TEACHING AND EXAMINATION SCHEME

Semester	**III**								
Course code & course title		**Periods/Week (in hours)**			**Total Hours**	**Examination Scheme**			
						Theory Marks		**Practical Marks**		**Total Marks**
(EL 304) Generation and Transmission of Electrical Energy		L	T	P	H	TH	TM	TW	PR/OR	
		3	-	-	3	75	25	-	-	100

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

EL304.CO1: Explain terms and functions of components of generation & transmission systems.
EL304.CO2: Illustrate the working of generating stations with sketch, layout and identify their advantages and limitations.
EL304.CO3: Analyze performance of generation and transmission systems.
EL304.CO4: Compare different types of power generation and transmission systems.

4. MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation& Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
EL304.CO1	3	2	2	-	3	2	2
EL304.CO2	3	3	2	1	3	3	2
EL304.CO3	3	3	2	3	1	3	3
EL304.CO4	3	3	2	1	3	2	2

Relationship : Low-1 Medium-2 High-3

	PSO1	PSO2
EL304.CO1	1	2
EL304.CO2	2	1
EL304.CO3	2	1
EL304.CO4	1	1

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks | **Thr = Teaching hours** | **CO = Course Objectives**			
Unit	**M**	**Thr**	**CO**
1. GENERATION	**21**	**14**	**CO1, CO2, CO4**
1.1 Sources of energy – Renewable & Non Renewable & their Comparison Conventional Power generating stations: selection of site a) Thermal power station: schematic diagram, List of main parts/components & their functions, advantages & disadvantages b) Hydro power station: Layout of hydro power stations, List of main parts/components & their functions, advantages & disadvantages c) Nuclear power station: schematic diagram and working of nuclear power station, Construction and working of nuclear reactor, advantages & disadvantages d) Diesel power generation Diesel generator set– List of main components & their functions, advantages & disadvantages			
1.2 Non-Conventional Power Generating Stations: Solar Electric power Generation : Concept of solar photovoltaic power generation with Schematic diagram, List of main components & their function Concept of Solar thermal power generation with schematic diagram, List of main components & their functions, advantages & disadvantages f) Wind electric power generation: Basic Block diagram and working, List of main components & their function, advantages & disadvantages			
2. ECONOMICS OF POWER GENERATION	**12**	**06**	**CO1, CO4**
2.1 Definitions: Firm load, cold reserve, hot reserve, spinning reserve (No Numerical) Terms: connected load, average demand, maximum demand, plant capacity factor and plant use factor, diversity factor, load factor (numerical). Concept of base load and peak load power plant			
2.2 Choice of number and rating of units for a given load curve (No Numerical) Grid system their merits and demerits			

3. TRANSMISSION LINE COMPONENTS	**21**	**14**	**CO1, CO3, CO4**
3.1 Necessity to step up the generated voltage before transmission Transmission line components & their functions: Conductor : AAC, ACSR, All Aluminium alloy conductor, bundled conductor (mechanical & Electrical properties) Supports: Features of R.C.C. poles, M.S. Steel poles, classification of towers – Single & Double circuit tower & their comparison Insulator: Pin type, Disc type, stay insulators, comparison between pin and Disc insulator. Causes of Failure of insulators. Distribution of potential over a string of suspension insulators, concept of string efficiency, methods of improving string efficiency Corona - Theory of corona formation, advantages and disadvantages, factor affecting corona, methods of reduction.			
3.2 Concept, Advantages and limitations of Extra high voltage transmission system. Concept & Block diagram of HVDC transmission with its advantages and limitation. Comparison between EHV-AC and HVDC transmission.			
4. PERFORMANCE OF TRANSMISSION LINE	**15**	**10**	**CO1, CO3, CO4**
4.1 Transmission line parameters: R, L, C of single phase and three phase transmission line (numerical but no derivation) Concept of Skin effect, proximity effect and Ferranti effect. Concept & need of transposition of conductors			
4.2 Classification of transmission lines (short, medium and long) Losses, efficiency and regulation of line Short transmission line-Performance with numerical (no derivation), Effect of load power factor on performance. Medium transmission line: Brief description and representation of T and π method (no derivation, no numerical)			
5. ERECTION OF TRANSMISSION LINE	**06**	**04**	**CO1**
Line configuration Erection of transmission line: brief description on erection of tower, fixing of insulators, Stringing of conductors Concept of sag & its importance, vibration in conductors their effect and methods of reduction (Dampers)			
Total	**75**	**48**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	Number of lectures	Marks
1	GENERATION	14	21
2	ECONOMICS OF POWER GENERATION	06	12
3	TRANSMISSION LINE COMPONENTS	14	21
4	PERFORMANCE OF TRANSMISSION LINE	10	15
5	ERECTION OF TRANSMISSION LINE	4	6
	Total	48	75

8. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	V.K. Mehta	Principle of Power System	S. Chand
2	J. B. Gupta	A course in Power system	S.K. Kataria & Sons
3	Dr. S. L. Uppal	Electrical Power	Khanna Publishers
4	J. B. Gupta	Electrical Installation Estimation & Costing	S.K. Kataria & Sons

Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	Raina, Anand & Singhal	Transmission & Distribution of Electrical Energy	

(EL305) ELECTRICAL DRAWING USING CAD

1. COURSE OBJECTIVES

This course will enable the students to use key features of CAD for professional electrical design and drafting.

2. TEACHING AND EXAMINATION SCHEME

Semester	**III**								
Course code & course title		**Periods/Week (in hours)**			**Total Hours**	**Examination Scheme**			
						Theory Marks		**Practical Marks**	**Total Marks**
(EL 305) Electrical Drawing using CAD		L	T	P	H	TH	TM	TW	PR/OR	
		-	-	4	4	-	-	50	50(P)	100

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

EL305.CO1: Choose appropriate commands to develop various electrical drawings using CAD.
EL305.CO2: Demonstrate use of CAD for electrical and electronics circuit drawing.
EL305.CO3: Make use of CAD and drawing skills to prepare wiring layouts and wiring diagram.
EL305.CO4: Develop drawing for electrical equipment.

4. MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation& Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
EL305.CO1	1	1	-	3	-	1	3
EL305.CO2	2	1	-	3	-	2	3
EL305.CO3	2	2	2	3	2	2	3
EL305.CO4	2	2	2	3	1	2	3

Relationship : Low-1 Medium-2 High-3

	PSO1	PSO2
EL305.CO1	2	2
EL305.CO2	2	2
EL305.CO3	3	3
EL305.CO4	3	3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	**Thr = Teaching hours**	**CO = Course Objectives**

Unit	**M**	**Thr**	**CO**
1**. INTRODUCTION TO CAD PRELIMINARIES AND HANDS ON PRACTICE OF COMMANDS**.		**14**	**CO1**
1.1. Setting up new drawing: Units, Limits, Grid, Snap			
1.2. Drawing basic objects: Point, Line, Circle, Arc, Ellipse, Parabolas, polygon, Rectangle, Multiline, drawing with precision, drawing construction lines and rays, calculating distance and angle, use of measure, divide, inquiry commands, redraws and regenerating screen display. Using Object snap: Endpoint, midpoint, Intersection, Centre Point, Quadrant point, Nearest Perpendicular, Apparent Intersection, etc.			
1.3. Edit/modify features and viewing drawings: Object selection: selection set with its options like pick box, window, crossing, previous, last drawing etc. Editing commands – zoom all, zoom previous, zoom extents, zoom window, zoom real time, zoom dynamic, zoom pan Modify commands: erase, copy, mirror, offset, array, move, scale, stretch, lengthen, trim, extend, rotate, break, join, chamfer, fillet,			
1.4. Organising Drawing: concept of layers: creating layers, naming layers, making layers ON/OFF, freeze thaw layers, lock/unlock layers, setting the properties of layers like colour, line type, line weight. Concept of blocks: creating, inserting, redefining, and exploding blocks. Concept of hatch: selecting hatch pattern, hatch styles, hatch orientation, associative hatch, boundary hatch, hatching object.			
1.5 Dimensioning and Tolerance: Dimensioning and editing dimensions. Single line text, multiline text.			
1.6 Printing/ Plotting drawing: Standard sizes of sheet. Selecting various plotting parameters such as paper size, paper units, drawing orientation, plot scale, plot offset, plot area, print preview.			
2. DRAWING OF SYMBOLS FOR BASIC ELECTRICAL, ELECTRONICS AND SUBSTATION EQUIPMENT.		**08**	**CO1** **CO2** **CO3** **CO4**
3. i) DRAWING OF COMPONENTS OF ELECTRICAL MACHINES AND DIFFERENT TYPES OF STARTERS. Different parts of transformers, AC and DC motors and their starting methods **ii) DRAWING OF SIMPLE BASIC ELECTRONIC CIRCUITS.** Basic rectifier circuit, transistor biasing circuit.		**16**	**CO1** **CO2** **CO4** **CO3**
4 i) DRAWING OF ELECTRICAL POWER SYSTEM COMPONENTS Transmission and distribution line components, pole mounted substation and single line diagrams		**14**	**CO1** **CO2** **CO3** **CO4**

ii) DRAWING OF ELECTRIC CIRCUIT DIAGRAM FOR REFRIGERATOR, WINDOW AC, SPLIT AC, OVEN, HPMV LAMP, HPSV LAMP.			
5. **DOMESTIC AND INDUSTRIAL INSTALLATION WIRING**		**12**	**CO1 CO2 CO3**
5.1 Wiring diagrams for domestic installation.			
5.2 Wiring diagram for installation of 3 phase induction motor			
Total		**64**	

6. COURSE DELIVERY:

The Course will be delivered through practicals, laboratory interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	**Unit**	**Number of hours**
1	INTRODUCTION TO CAD PRELIMINARIES AND HANDS ON PRACTICE OF COMMANDS	14
2	DRAWING OF SYMBOLS FOR BASIC ELECTRICAL, ELECTRONICS AND SUBSTATION EQUIPMENT	08
3	DRAWING OF COMPONENTS OF ELECTRICAL MACHINES AND DIFFERENT TYPES OF STARTERS . AND DRAWING OF SIMPLE BASIC ELECTRONIC CIRCUIT	16
4	DRAWING OF ELECTRICAL POWER SYSTEM COMPONENTS AND DRAWING OF ELECTRIC CIRCUIT DIAGRAM FOR REFRIGERATOR, WINDOW AC,SPLIT AC, OVEN, HPMV LAMP, HPSV LAMP.	14
5	DOMESTIC AND INDUSTRIAL INSTALLATION WIRING	12
	Total	64

8. SPECIFICATION TABLE FOR TERM WORK

Term Work shall consists of minimum 6 No's of Electrical Drawing Sheets using CAD and minimum two on full imperial drawing sheets (or 4 half imperial)

Sr No	Drawing sheet details	Marks
1	Basic electrical, electronics and substation equipment symbols.	
2	Transformer Details : core, winding , tank & other accessories	
3	Components of DC motor	
4	Three phase squirrel cage and slip ring induction motor and their parts.	
5	Dc and AC Motor Starters (4-point starter, DOL starter, Star Delta Starter { Manual & Automatic},Autotransformer starter, rotor resistance starter)	
6	Transmission and distribution line components	
7	Layout of 11 KV/0.4 KV H pole mounted substation.	
8	Single line diagram of Extra High Voltage (220KV or 110 KV)substation	
9	Drawing of wiring diagram for domestic installation	
10	Drawing of wiring diagram for 3 phase induction motor	
11	Drawing basic rectifier circuits	
12	Drawing transistor biasing circuits	
13	Drawing electrical wiring diagram for refrigerator, window AC, split AC, Oven, HPMV lamp, HPSV lamp.	
	Total	50

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	P. Nageshwar Rao	AutoCAD for Engineering drawing made easy	Tata McGraw Hill.
2	George Omura	Mastering AutoCAD	BPB Publication
4	Raina ,Bhattacharya	Electrical design ,Estimating and costing	New Age International
5.	P. S. Bhimbra	Power Electronics	Khanna Publisher
6.	V. K. Mehta, Rohit Mehta	Principles of Electronics	S. Chand

(CC309) DIGITAL ELECTRONICS

1. COURSE OBJECTIVES:

The students need to learn basic concepts of digital circuits and system which leads to design of complex digital system such as microprocessors.

The students need to know combinational and sequential circuits using digital logic fundamentals. This is the first course by which students get exposure to digital electronics world.

The students will able to

1. To understand various number representations and conversion between different representation in digital electronic circuits.
2. To introduce the students to various logic gates, SOP, POS and their minimization techniques.
3. To analyze logic processes and implementation of logical operations using combinational logic circuits.
4. To understand, analyze and design sequential circuits

2. TEACHING AND EXAMINATION SCHEME

Semester	**III**								
Course code & course title		**Periods/Week (in hours)**			**Total Hours**	**Examination Scheme**			
						Theory Marks		**Practical Marks**		**Total Marks**
Digital Electronics CC309		**L**	**T**	**P**	**H**	**TH**	**TM**	**TW**	**PR/OR**	
		03	**-**	**02**	**05**	**75**	**25**	**25**	**25**	**150**

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

CC309.CO1: Relate the knowledge of Number Systems in Digital Applications.

CC309.CO2: Build different Sequential and Combinational Circuits.

CC309.CO3: Simplify logical problems using digital circuits.

CC309.CO4: Develop basic digital electronics circuits.

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4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation & Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
CC309.CO1	3	2	3	3	0	0	3
CC309.CO2	3	3	3	3	3	3	3
CC309.CO3	3	3	3	3	3	0	3
CC309.CO4	3	3	3	3	2	2	3

Relationship : Low-1 Medium-2 High-3

	PSO1	PSO2
CC309.CO1	1	-
CC309.CO2	3	2
CC309.CO3	2	1
CC309.CO4	2	1

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	**Thr = Teaching hours**	**CO = Course Objectives**	

Unit	**M**	**Thr**	**CO**
1 Number System	**14**	**09**	**CO1**
1.1 **Digital and Analog Signals**. Definition of digital and analog signals,Comparison between Analog and Digital signals			
1.**2 Number System**:- Decimal, Binary, Hexadecimal. Introduction to Decimal,Binary and Hexadecimal Number Systems. Counting in each system. Conversion from one system to other.			
1.3 Codes:- introduction and importance of Codes.BCD code, GRAY code conversion of Gray to Binary, Binary to Gray, BCD to binary and Binary to BCD. Represent Decimal Numbers in BCD and Gray codes. ASCII code and its importance.			
1.4 Binary Addition (upto 4 bits), 1's complement of a Binary number, 2's complement of a Binary number. Binary Subtraction using 2's complement method. Addition of signed decimal numbers.			
2Combinational Circuits	**19**	**12**	**CO1,CO2,CO3**
2.1 Logic Gates:- Symbol, Expression and Truth Tables of Basic gates(AND,OR,NOT) and Combinational gates(NOR,NAND,EXOR,EXNOR).			
2.2 Boolean Algebra:- DeMorgan's Theorems, Laws of Boolean Algebra ,Duality Theorem,			
2.3Simplification of Boolean Expressions using Boolean Algebraic laws and by using K-Maps Techniques(upto 4 Variables in SOP Form),			
2.4 Universal Gates:- Implementation of NOT,OR,AND,EXOR gates using NOR and NAND Gates			
2.5Adders:- Half Adder circuit using logic gates , Full Adder circuit using logic gates, block diagram of 4 bit parallel adder. Subtractors:- Half subtractor circuit using logic gates, Full Subtractor using logic gates			
2.6Combinational circuits:- Block diagram and Implementation using basic gates:- Multiplexers(4 to 1), Demultiplexer(1 to 4), Encoder (4 to 2), Decoder(2 to 4). BCD to 7 segment Decoder driver (Common Cathode).			
3 Flip Flops	**12**	**08**	**CO1,CO2,**
3.1 Definition of FlipFlop. Applications. Symbol, Truth Tables, Operation and timing diagrams of RS F/F using NAND gates. ,			
3.2 Symbol, Truth Tables, Operation and timing diagrams			

of clocked RS F/F using NAND Gates, Concept of Asynchronous inputs(Preset and Clear)			
3.3 Symbol, Truth Tables, Operation of Clocked D F/F			
3.4 Symbol, Truth Tables, Operation of Clocked JK F/F, Excitation table of JK flip flop			
3.5 Race around condition in JK F/F. Symbol, Truth Tables, Operation of JK master slave F/F.			
3.6 Symbol, Truth Tables, Operation of T F/F,			
4 Registers And Counters	**19**	**12**	**CO1,CO2,CO4**
4.1 Registers: Definition of Shift Registers, Applications of Registers Symbols and Logic block diagram of SISO,SIPO,PISO and PIPO Registers,			
4.2 Serial IN Serial Out Register (size of the register 4 bits) Logic Diagram and Operation of SISO Register usingnegative edge triggered D F/F along with the Truth Table and Timing diagrams			
4.3 Serial IN Parallel Out Register (size of the register 4 bits) Logic Diagram and Operation of SIPO Register using negative edge triggered D F/F along with the Truth Table and Timing diagrams.			
4.4 Parallel IN Serial Out Register (size of the register 4 bits) Logic Diagram and Operation of PISO Register using negative edge triggered D F/F along with the Truth Table and Timing diagrams			
4.5 Parallel In Parallel Out Register (size of the register 4 bits) Logic Diagram and Operation of PISO Register using negative edge triggered D F/F along with the Truth Table and Timing diagrams . Concept of Shift right, Shift left, Ring Counter.			
4.6 Counters: Introduction to counters, Modulus of counters. Count sequence, No of Flip Flops required for Specified counters			
4.7 Asynchronous Counters:- 4 bit UP counter using JK Flip Flops only and 4 bit DOWN counter using JK Flip Flops only.			
4.8 Synchronous Counters:- 4 bit UP counter using JK Flip Flops only and 4 bit DOWN counter using JK Flip Flops only, Decade (Mod 10) using JK Flip Flops only			
4.9 Design of Synchronous counters(upto 4 bit) using only JK Flip Flops			
5 DAC and ADC and Memories	**11**	**7**	**CO1,CO4**
5.1 Definitions, Types of DAC and ADC(noDescription),Applications		1	
5.2 Binary Ladder Network for DAC:- Logic circuit and operation. Simple numerical problems		4	

Successive Approximation ADC .:- Logic circuit and operation. Simple numerical problems.			
5.3Memories: Introduction, Semiconductor memories and its types –ROM,RAM,PROM, EPROM,EEPROM(only definition and applications)		2	
Total	**75**	**48**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	**Unit**	**Number of lectures**	**Marks**
1	**Number System**	09	14
2	**Combinational Circuits**	12	19
3	**Flip Flops**	08	12
4	**Registers And Counters**	12	19
5	**DAC and ADC**	07	11
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK

No	**Practical (Perform any 8)**	**Marks**
1.	Verification of Logic gates and Demorgan's Theorems	
2.	Universal gates (NAND and NOR)	
3.	Verification of Boolean Expression	
4.	Half Adder and Full Adder using logic gates	
5.	Half Subtractor and Full Subtractor using logic gates	
6.	MUX and D-MUX	
7.	RS F/F, D F/F and JK F/F	
8.	Assemble and Test Binary Counter/Decade counter	
9.	Assemble and test DAC using DAC0808	
10.	Assemble and test ADC using ADC0808	
	Total	25
...		
No	Class room Assignments	
	At least 2 assignments	
No	**Tutorial Exercise**	**Marks**
1	NIL	
...	Total	

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	R.P.Jain,	Modern Digital Electronics	Fourth Edition, Tata McGraw-Hill Education.
2	Malvino & Leach,	Digital Principles and Applications	Seventh Edition, McGraw-Hill Education

Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	Thomas L. Floyd,	Digital Fundamentals	10th Edition, Pearson Education Inc, 2011
2	A.K. Maini,	Digital Electronics: Principles and Integrated Circuits	Wiley India Publications

SEMESTER IV

(EL401) ELECTRICAL MACHINES II

1. COURSE OBJECTIVES:

This subject enables the student to understand the working principle, construction, performance & characteristics, control and applications of various AC electrical machines such as Induction motor (single phase & three phase), alternator, synchronous motor and other AC motors. The students would get acquainted with the knowledge regarding analyzing the various parameters of these machines and also get familiarized with the various starting methods & starters used for starting of these machines along with their control circuits

2. TEACHING AND EXAMINATION SCHEME

Semester	**IV**								
Course code & course title		**Periods/Week (in hours)**			**Total Hours**	**Examination Scheme**			
						Theory Marks		**Practical Marks**		**Total Marks**
(EL401) Electrical Machines II		L	T	P	H	TH	TM	TW	PR/OR	
		4	-	2	6	75	25	25	25(P)	150

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

EL401.CO1: Explain principle of operation and construction of A.C. Machines
EL401.CO2: Demonstrate parallel operation of Alternators and various methods of starting, speed control of A.C. Motors.
EL401.CO3: Compare different types of A.C. machines and their starters
EL401.CO4: Evaluate voltage regulation and efficiency of A.C. machines

4. MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation& Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
EL401.CO1	2	-	-	-	-	3	2
EL401.CO2	3	3	2	3	2	3	3
EL401.CO3	2	2	-	-	-	3	3
EL401.CO4	3	3	2	3	3	3	2

Relationship : Low-1 Medium-2 High-3

	PSO1	PSO2
EL401.CO1	1	-
EL401.CO2	2	2
EL401.CO3	1	-
EL401.CO4	1	1

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks | **Thr = Teaching hours** | **CO = Course Objectives**			
Unit	**M**	**Thr**	**CO**
1 CONSTRUCTION AND PERFORMANCE OF INDUCTION MOTOR	**21**	**18**	**CO1, CO3, CO4**
1.1 Fundamental principles of rotating machines: Production of rotating magnetic flux in a 3 phase winding using vector method, working principle of 3 phase Induction motor Constructional details and its types: List and functions of parts (stator core, stator winding, rotor for slip ring and squirrel cage) Terminal marking for three phase induction motor. Concept of slip, rotor frequency, rotor emf, rotor current under standstill and running condition.			
1.2 Phasor diagram at full load condition. Development of Equivalent circuit diagram.(no numerical) Power flow diagram and calculation of efficiency in induction motor Torque-slip characteristics of induction motor and effect of change in rotor resistance on characteristics. Definitions of pull up & pull out torque. Relationship between starting torque and full load torque, starting torque and maximum torque.(no derivation)			
2 INDUCTION MOTOR STARTERS	**09**	**06**	**CO 2, CO3**
2.1 Necessity of starters Concept and operation of: Direct on line starter (Power & control circuit) Manual star/delta starter, Manual auto transformer starter, Rotor resistance starters for slip ring induction motor (Power circuit only). Concept of soft starter and its advantages.			
3 ALTERNATORS	**24**	**23**	**CO1, CO2, CO3, CO4**
3.1 Construction and working of alternator Comparison of salient and cylindrical pole type Advantages of stationary armature & rotating magnetic field.			
3.2 concept of full pitched coil, fractional pitched coil, emf equation (no derivation). Coil span factor and coil distribution factor (no derivation), effects of these factors on generated emf Frequency of induced emf and factors on which it depends. Operation of alternator under no load & on load (with phasor diagram) Armature reaction in a three phase alternator (with vector diagram only) and effects of load power factor on it.			
3.3 Operating parameters –armature resistance, leakage reactance, synchronous reactance and synchronous impedance. calculation of synchronous impedance by O.C. and S.C. test Definition, importance and calculation of Voltage regulation(no derivation) Operating characteristics of alternator Specifications for procurement.			
3.4 Necessity & desirable conditions for parallel operation of alternators, brief explanation of synchronizing alternators by (2 bright-1 dark lamp method and Synchroscope method)			
4 SYNCHRONOUS MOTOR	**09**	**05**	**CO1, CO2**
4.1 Principle of operation, methods of starting and Applications .			

Definition of load angle. Final Torque and power equations of a synchronous motor, Variation of currents and power factor under variable excitation & constant load (V-curve). Concept of synchronous condenser. Hunting and use of Damper windings			
5 SINGLE PHASE MOTORS	**12**	**12**	**CO 1, CO2, CO3**
5.1 Single Phase Induction Motors: Construction and classification, torque-speed characteristics (Double revolving field theory) Connection Diagram , working, application of: Capacitor start, capacitor start and run, permanent capacitor and shaded pole			
5.2 Universal motor, repulsion motor, stepper motor, servo motor			
Total	**75**	**64**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	**Unit**	**Number of lectures**	**Marks**
1	CONSTRUCTION AND PERFORMANCE OF INDUCTION MOTOR	18	21
2	INDUCTION MOTOR STARTERS	06	09
3	ALTERNATORS	23	24
4	SYNCHRONOUS MOTOR	05	09
5	SINGLE PHASE MOTORS	12	12
	Total	64	75

8. SPECIFICATION TABLE FOR TERM WORK

No	**Practical (Minimum 8)**	**Marks**
1.	To perform no load & blocked rotor test on a 3 phase induction motor and: a) Determine its equivalent circuit parameters, total losses & efficiency, b) Plot the circle diagram to determine the total losses & efficiency.	
2.	To perform load test on a 3 phase induction motor and determine efficiency and variation of speed, power factor with the load.	
3.	Identification of parts and their functions in the following starters and their specifications:- DOL , autotransformer, star delta, rotor rheostat starters	
4.	Starting & reversal of direction of rotation of a 3 phase &1 phase induction motor.	
5.	To perform no load & blocked rotor test on a 1 phase induction motor and determine its efficiency.	
6.	To perform O.C & S.C test on an alternator and determine its synchronous impedance and voltage regulation.	
7.	To determine the excitation required to maintain constant voltage in an alternator under varying voltages	
8.	To plot “V curves” for a synchronous motor.	

9.	To perform the parallel operation of alternators.	
10.	To study the performance of special motors w. r. t current drawn, power consumed, sparking at the brushes and noise level.	
11.	Field visit.	
	Total	25

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	S.K. Bhattacharya	Electrical machinery	Tata Mcgraw
2	J. B. Gupta.	Theory & performance of Electrical Machines	S. K. Kataria & sons
3	B. L. Theraja.	Electrical Technology (Vol II)	S Chand
4	P.S. Bhimbra.	Elementary theory of electrical machines	Khanna Publishers

(EL402) APPLIED AND INTEGRATED ELECTRONICS

1. COURSE OBJECTIVES

This course includes study of electronic devices and circuits like rectifiers, regulators, amplifiers, oscillators and basics of integrated electronics. An understanding of these will provide a good platform to the students to enter into more complex and specialized fields of Electrical and Electronics Engineering.

2. TEACHING AND EXAMINATION SCHEME

Semester	**IV**								
Course code & course title		**Periods/Week (in hours)**			**Total Hours**	**Examination Scheme**			
						Theory Marks		**Practical Marks**	**Total Marks**
(EL402) Applied And Integrated Electronics		L	T	P	H	TH	TM	TW	PR/OR	
		3	-	2	5	75	25	25	25(O)	150

3.COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

EL402.CO1: Illustrate the operation and characteristics of semiconductor devices.
EL402.CO2: Explain applications of integrated circuits.
EL402.CO3: Demonstrate the working of various Electronic circuits.
EL402.CO4: Discuss the applications of semiconductor devices.

4. MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation& Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
EL402.CO1	3	2	-	3	-	3	1
EL402.CO2	3	3	2	3	3	3	3
EL402.CO3	3	3	2	3	3	3	3
EL402.CO4	3	3	-	3	-	3	3

Relationship : Low-1 Medium-2 High-3

	PSO1	PSO2
EL402.CO1	3	-
EL402.CO2	3	2
EL402.CO3	3	2
EL402.CO4	3	2

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks | **Thr = Teaching hours** | **CO = Course Objectives**			
Unit	**M**	**Thr**	**CO**
1. DIODES	**12**	**7**	**CO1, CO3, CO4**
1.1 PN Junction diode Construction, Symbol, PN junction with Forward and Reverse bias and V-I characteristics. PN junction diode as a Rectifier-Half wave Rectifier, Full Wave Rectifier, Bridge Type Rectifier. (Circuit diagram, operation and relevant waveforms)			
1.2 Zener Diode Concept of Zener breakdown, Construction of Zener diode, Symbol, VI Characteristics, List its various Applications. Zener Diode as a voltage Regulator (Circuit Diagram and Operation) Photodiode -Principle of Operation, symbol, characteristics ad Applications. Light Emitting Diode-Principle of Operation, symbol, characteristics and Applications			
2. TRANSISTORS	**15**	**11**	**CO1, CO3, CO4**
2.1 BJT Basic Construction, Terminals, BJT types -NPN and PNP, Transistor action and working of NPN and PNP. Transistor current components, Current amplification Factors, Relation between α and ß. Basic Configurations- CB,CE,CC-Input and Output characteristics of each, concept of Active region, Saturation region and cut off region in each case, comparison between CB, CE, CC.			
2.2 Transistor Biasing and Applications Need for biasing, Transistor Load lines- DC and AC Load Line, Q-point and its selection Criterion, Fixed Bias, Emitter Stabilized Bias and Voltage Divider Bias (Circuit Diagram, output Characteristics with load line points, Expression for input current, output current and output voltage in each case) , Merits, Demerits of each Biasing network. Applications of Transistor: Operation of Transistor as a switch and Operation of Transistor Amplifier.			
3. AMPLIFIERS AND OSCILLATORS	**18**	**13**	**CO3, CO4**
3.1 Small Signal Amplifier Concept of Zi, Zo, Av and Ai, Single Stage CE Amplifier (circuit, working, Frequency response) Concept of Multistage Amplifiers-Methods of Coupling-RC, Direct, Transformer Coupling (difference between them.) Two Stage RC coupled amplifier and Two stage Direct Coupled			

Amplifier (circuit diagram and Frequency response)			
3.2 Power Amplifier Concept of Power amplifiers & Classification (Class A,B,C) Transformer Coupled Class A Power Amplifier, Class B Push Pull Power Amplifier and Class C Power Amplifier.(No Derivation).			
3.3 Oscillators Concept of Positive feedback, Barkhausen's Criterion. RC Oscillator-Circuit and Operation of RC Phase Shift oscillator, Expression for Frequency. LC Oscillator- Concept of tank circuit- Circuit and Operation of Tuned Collector Oscillator Limitations of LC and RC Oscillators Crystal Oscillator- Circuit and Operation, Expression for Frequency.			
4. OPERATIONAL AMPLIFIER	**15**	**9**	**CO2**
4.1 Introduction- Concept of Differential Amplifier, Different modes of Operation- DIBO, DIUO. Block Diagram and working of Op Amp, Schematic diagram, Equivalent Circuit, Symbol and Pin Configuration of IC741. Opamp parameters Input Offset Voltage, Output Offset Voltage, Input Offset Current, Input Bias Current, CMRR, Slew Rate (Only definitions and typical values), Characteristics of Ideal and Practical Opamp, Concept of virtual ground.			
4.2 Modes of Operation of Opamp Inverting and Non inverting mode (circuit diagram, analysis and Operation), Voltage follower circuit and its applications.			
UNIT 5- APPLICATIONS OF OPAMP	**15**	**8**	**CO2, CO3**
5.1 Op-amp as a adder, subtractor (Circuit diagram, analysis, output expression) Op-amp as Zero Crossing Detector and Schmitt Trigger (No derivation, Only circuit diagram, operation and relevant Waveforms.) Op-amp as an Integrator and Differentiator. (Circuit diagram, analysis, output expression.)			
5.2 Introduction to IC 555-Block Diagram-construction and operation, Pin Configuration Applications- Astable , monostable multivibrator.			
TOTAL	75	48	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	Number of lectures	Marks
1	DIODES	7	12
2	TRANSISTORS	11	15
3	AMPLIFIERS AND OSCILLATORS	13	18
4	OPERATIONAL AMPLIFIER	9	15
5	APPLICATIONS OF OP-AMPS	8	15
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK

No	**Practical** (Minimum 8)	Marks
1.	To verify the working of a PN junction diode as a Half wave Rectifier.	
2.	To verify the working of a PN junction diode as a Full Wave Rectifier.	
3.	To verify the working of a Zener Diode as a voltage regulator for change in supply voltage and load.	
4	To plot Input and Output Characteristic of CE amplifier	
5	To verify Q point parameters for a Fixed Bias circuit	
6.	To verify Q point parameters for a Voltage divider Bias circuit.	
7.	To plot frequency Response curve for a single stage RC coupled amplifier.	
8.	To study the operation of RC Phase shift Oscillator and to verify the frequency of oscillation.	
9.	To verify the working of Opamp in Inverting and Non inverting Mode	
10.	To verify the working of Opamp as an Adder and Subtractor	
11.	To verify the working of Opamp as Integrator and Differentiator	
12.	To verify the working of Opamp as Zero crossing detector.	

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	Dr. S. K. Bhattacharya, Dr. Reu Vig	Principles Of Electronics	S.K Kataria & Sons
2	J. B. Gupta	Basic Electronics	S.K Kataria & Sons
3	V.K Mehta	Principles Of Electronics	S. Chand & Company

Reference Books For Further Study

S. No.	Author	Title Of Books	Publishers
1	J. B. Gupta	Electronic Devices & Circuits	Katsons
2	Ramakant Gayakwad	Linear Integrated Circuits	Prentice Hall Of India

Indian And International Codes Needed

S. No.	Author	Title Of Books	Publishers
1	Robert Boylestead	Electronic Devices & Circuits	Prentice Hall Of India
2	B.P. Singh Rekha Singh	Electronic Devices & Integrated Circuits	Pearson Education

(EL404) ELECTRONIC INSTRUMENTATION SYSTEMS

1. COURSE OBJECTIVES

This course enables students to understand the facts, concepts, principles and applications of instrumentation system. The student will be able to conduct installation, testing and commissioning especially related with transducers and control system, in the field of electrical and electronics.

2. TEACHING AND EXAMINATION SCHEME

Semester IV									
Course code & course title	**Periods/Week (in hours)**			**Total Hours**	**Examination Scheme**				
					Theory Marks		**Practical Marks**		**Total Marks**
(EL404) Electronic Instrumentation Systems	L	T	P	H	TH	TM	TW	PR/OR	125
	3	-	2	5	75	25	25	-	

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:
EL404.CO1: Explain functions of components of instrumentation system.
EL404.CO2: Illustrate use of transducer for measurement of given quantities.
EL404.CO3: Discuss the working and applications of various components of instrumentation system.
EL404.CO4: Select suitable instrumentation system for a given measurement application

4. MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation & Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
EL404.CO1	2	-	-	-	-	3	3
EL404.CO2	3	3	2	3	3	3	3
EL404.CO3	2	1	2	3	3	3	3
EL404.CO4	2	3	3	3	3	3	3

Relationship : Low-1 Medium-2 High-3

	PSO1	PSO2
EL404.CO1	3	-
EL404.CO2	3	2
EL404.CO3	3	2
EL404.CO4	3	2

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks | **Thr = Teaching hours** | **CO = Course Objectives**			
Unit	**M**	**Thr**	**CO**
1. INTRODUCTION TO INSTRUMENTATION	**9**	**6**	**CO1, CO2, CO3**
Objective of instrumentation system, Block diagram of a general instrumentation system. Characteristics of ideal transducer, Classification of transducers: Active and passive transducers, Analog and digital transducers.			
2. TRANSDUCERS	**18**	**14**	**CO1, CO2**
2.1 Construction, operation and characteristics of passive transducers: Resistive transducers: Potentiometer, strain guage, (bonded and semiconductor) RTD, Thermistor Inductive transducers: by varying self inductance, mutual inductance, eddy current. LVDT Capacitive transducers: varying of distance, area, permitivity			
2.2 Active transducers (principle ,working and material used) Piezoelectric transducer Thermocouple Photoelectric transducers: LDR, Photodiode, Photo transistor, Photovoltaic cell Digital transducer: Shaft encoder			
3. TRANSDUCER APPLICATIONS	**21**	**14**	**CO1,CO2, CO4**
3.1 Displacement measurement: linear and angular displacement using resistive, capacitive, and inductive transducers. Angular speed measurement: photoelectric pickup, magnetic pickup Vibration measurement: piezoelectric accelerometer			
3.2 Pressure measurement: diaphragm with strain gauge Level measurement: Float operated, resistive method, capacitive method Flow measurement: electromagnetic flow meter and turbine meter			
4. SIGNAL CONDITIONING AND DATA PRESENTATION	**18**	**8**	**CO1, CO3**
4.1 Signal Conditioning: Need for signal conditioning Significance of DC & AC amplifiers, Instrumentation amplifier. Filters: Concept, significance, circuit (using passive components only) and characteristics of low pass, high pass and band pass filters Basic bridge circuits for strain gauge and RTD			
4.2 Data presentation elements: Digital display: Advantages and comparison of LED and LCD. Plotters: Strip chart recorder, XY plotter.			
5. APPLICATION OF INSTRUMENTATION SYSTEM	**9**	**6**	**CO1, CO3**
5.1 Block diagram, working and applications of Data acquisition system SCADA Process control			
Total	**75**	**48**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	Number of lectures	Marks
1	INTRODUCTION TO INSTRUMENTATION	6	9
2	TRANSDUCERS	14	18
3	TRANSDUCER APPLICATIONS	14	21
4	SIGNAL CONDITIONING AND DATA PRESENTATION	8	18
5	APPLICATION OF INSTRUMENTATION SYSTEM	6	9
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK

No	**Practical** (Minimum 8)	Marks
1.	Displacement measurement using resistive transducer	
2.	Displacement measurement using inductive transducer	
3.	Displacement measurement using Capacitive Transducer	
4.	Displacement measurement using LVDT	
5.	Stress measurement using strain gauge.	
6.	Temperature measurement using resistance temperature detector	
7.	Temperature measurement using thermocouple	
8.	Speed measurement of motor using photo electric pickup/ magnetic pick up.	
9.	Level measurement transducer.	
10.	Obtain characteristics of Photodiode and phototransistor.	
11.	Obtain characteristics of LDR.	
12.	Study of piezoelectric transducer.	
	Total	25

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	Sawhney A. K.	Electrical & Electronic measurement and instruments	Khanna Publisher
2	Rangan, C.S. et al	Instrumentation Devices and system	Tata Mc Graw Hill
3	Curtis Jhonson	Process control instrumentation Technology	Pearson/Prentice hall
4	Kalsi H. S.	Electronic instruments and measurement	Mc Graw Hill

Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	Murty, D.V.S.	Transducers and Instrumentation	Prentice Hall India

(EL405) ELECTRICAL & ELECTRONICS WORKSHOP

1. COURSE OBJECTIVES

The course content will enable the students to learn symbols used for various electrical appliances, making wire joints, crimping of lugs, coil winding and to develop hand on skill for domestic wiring works, estimation of bill of materials and repairs & maintenance of various domestic appliances

2. TEACHING AND EXAMINATION SCHEME

Semester	**IV**								
Course code & course title		**Periods/Week (in hours)**			**Total Hours**	**Examination Scheme**			
						Theory Marks		**Practical Marks**		**Total Marks**
		L	**T**	**P**	**H**	**TH**	**TM**	**TW**	**PR/OR**	
(EL405) Electrical & Electronics Workshop		-	-	4	4	-	-	50	25(O)	75

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

EL405.CO1: Demonstrate the use of series test lamp, multimeter, MCB, MCCB, ELCB and crimping tool.

EL405.CO2: Choose appropriate tools and equipments and apply the skills for carrying out repair and maintenance works of domestic appliances.

EL405.CO3: Prepare plan for domestic wiring works and estimate the material required for the same.

EL405.CO4: Design and develop a mini project and fabricate the PCB required for the same

4. MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation & Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
EL405.CO1	3	2	1	3	1	3	2
EL405.CO2	3	2	1	3	1	3	3
EL405.CO3	3	3	3	3	2	3	3
EL405.CO4	3	3	3	3	2	3	3

Relationship : Low-1 Medium-2 High-3

	PSO1	PSO2
EL405.CO1	2	-
EL405.CO2	3	3
EL405.CO3	3	2
EL405.CO4	3	3

5. SPECIFICATION TABLE FOR TERM WORK

(Any 3 from first 5 experiments, experiments 6 to 10 are compulsory)

No	Practical	Marks
1.	Check fault in the electrical components/circuits using series test lamp, multimeter and meggar.	
2.	Practice of coil winding	
3.	Practicing of crimping different types of lugs	
4.	Study of MCB, MCCB, ELCB	
5.	Electrical maintenance of Air conditioner and Refrigerator	
6.	Connection of fluorescent tube light circuit, identifying its components and measuring of operating and conducting voltage	
7.	Planning, estimating material and connecting given circuit for small room wiring	
8.	Repair and maintenance of domestic appliances (Electrical) such as iron, ceiling fan, table fan, mixer, hot plate, oven, electric kettle, etc. (Minimum 4)	
9.	Repair and maintenance of domestic appliances (Electronics) such as stabiliser, washing machine, television, music stereo, CPU, power supply unit, etc. (Minimum 3)	
10.	Mini project on PCB making.	
	Total	50

6. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	K. B. Bhatia	Electrical appliances & devices	Khanna publishers

(EL407) DISTRIBUTION AND UTILIZATION OF ELECTRICAL ENERGY

1. COURSE OBJECTIVES

This course primarily deals with distribution and utilization of electrical energy. It will enable the students to understand terms related to distribution system, earthing and applications of electrical energy in heating welding traction and illumination.

2. TEACHING AND EXAMINATION SCHEME

Semester	**IV**								
Course code & course title		**Periods/Week (in hours)**			**Total Hours**	**Examination Scheme**			
						Theory Marks		**Practical Marks**	**Total Marks**
(EL407)		L	T	P	H	TH	TM	TW	PR/OR	
Distribution & Utilization of Electric Energy		3	-	2	5	75	25	25	-	125

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

EL407.CO1: Explain components and methods of distribution and utilization of electrical energy.
EL407.CO2: Apply various techniques for lighting, heating, welding and traction systems.
EL407.CO3: Compare different distribution system topologies, wiring systems ,welding and earthing types.
EL407.CO4: Choose suitable wiring, heating methods, lamps and traction motor for given applications.

4. MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation& Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
EL407.CO1	2	1	1	-	2	-	3
EL407.CO2	2	3	1	3	3	3	2
EL407.CO3	3	3	1	1	-	-	3
EL407.CO4	2	3	3	3	3	3	3

Relationship : Low-1 Medium-2 High-3

	PSO1	PSO2
EL407.CO1	3	-
EL407.CO2	3	2
EL407.CO3	3	-
EL407.CO4	3	2

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks | **Thr = Teaching hours** | **CO = Course Objectives**			
Unit	**M**	**Thr**	**CO**
1 DISTRIBUTION SYSTEM	**18**	**12**	**CO1, CO3**
1.1 Overview of distribution system- Single line diagram of power system. Comparison between overhead system and underground distribution system. Classification of distribution system w. r. t. Voltage & number of wires Circuit diagram and expression for DC 2 wire, AC 2 wire (single phase), AC 3 wire & AC 4 wire system. Their comparison with respect to Volume of conductor material for each type. Comparison between single phase and three phase distribution, comparison between 3 phase, 3 wire system and 3 phase 4 wire system. Rural electrification – Types & sizes of conductors used in rural electrification, Standard ratings of transformers used, Rural distribution systems - a) SWER b) ABC			
1.2 Components of distribution system Concept of feeder, distributor & service mains Types of distributor: Radial, ring & interconnected System & their comparison System voltage, permissible voltage drop in various parts of distribution system for urban, semi urban & rural areas.			
2. WIRING & EARTHING	**12**	**6**	**CO1, CO3, CO4**
2.1 Systems of Wiring Brief explanation, advantages, & disadvantages of Cleat Wiring, PVC casing capping, surface & concealed conduit wiring. Comparison between above wiring systems. Tee and Loop-in wiring system.			
2.2 Earthing Importance of Earthing, Standard Earthing practices. Methods & procedure of Earthing: Pipe & plate. Factors affecting earth resistance, methods of reducing earth resistance.			
3. ELECTRIC HEATING & WELDING	**27**	**20**	**CO1, CO2, CO3, CO4**
3.1 Introduction to heating: Modes of Heat transfer: Conduction, Convection & Radiation. Formula for Heat transfer by Conduction, Convection & Radiation (No Derivation) Advantages of Electric Heating.			

3.2 Resistance and Arc heating Resistance Heating: Concept of Direct and Indirect Resistance Heating Construction and working of Salt Bath Furnace, Batch type Resistance Furnace. Desirable properties of Heating Elements and materials used and causes of their failure. Temperature Control of Resistance Furnaces: ON-OFF Control, Variation of Number of Heating Elements, Variation in Circuit configuration, Change in Applied Voltage using (Bucking-Boosting of Secondary voltage, Auto-Transformer Control) Basic concept of Infrared heating & its applications Arc Heating: Basic concept, Direct Arc furnace & Indirect Arc furnace			
3.3 Induction and dielectric heating:- Induction Heating: Basic Concept of Induction Heating. Working of Ajax Wyatt Vertical Core Furnace & its advantages and disadvantages. Working of Coreless Induction Furnace & its advantages and disadvantages. High Frequency eddy current heating: Principle, working & applications Dielectric heating: - principle of operation & applications.			
3.4 Welding: Arc welding:-Principle of Arc Welding, Drooping characteristics of welding source, Comparison between AC & DC Welding, Arc Blow & method to reduce it. Resistance Welding: Flash Welding, Spot Welding, Seam Welding, Projection Welding, and their applications. Comparison between Arc & Resistance Welding.			
4 TRACTION	**9**	**4**	**CO1, CO2, CO4**
Advantages & Disadvantages of Electric Traction, Supply Systems of Electric Traction (DC, Single phase AC & Three phase AC) Speed time curves for main, sub-urban, & Urban trains (No Numerical) Requirements of Traction Motors Traction Current Collectors: Trolley Collector, Pantograph Collector. Overhead catenary construction for Tramways & Trolley Buses & Railways (single & compound)			
5 ILLUMINATION	**9**	**6**	**CO1, CO2, CO4**
5.1 Nature of Light, Terms used in Illumination – Luminous Flux, Lumen, Candle Power, Illumination, Brightness, Reflection factor, Maintenance factor, Utilization factor.			
5.2 Principle of Light production in Filament & Gas Discharge Lamps Working Principle of Incandescent lamp, Florescent lamp (including CFL), HPSV, HPMV, Halogen lamp, LED lamp Stroboscopic Effect.			
Total	**75**	**48**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	Number of lectures	Marks
1	DISTRIBUTION SYSTEM	12	18
2	WIRING & EARTHING	6	12
3	ELECTRIC HEATING & WELDING	20	27
4	TRACTION	4	9
5	ILLUMINATION	6	9
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK

No	Practical (Minimum 8)	Marks
1.	Visit to 11KV LT distribution system to identify its components and prepare a report on same.	
2.	Practice of simple wiring – wiring of fan, lamp and socket.	
3.	Study of different types of sources of light and make connections to measure intensity of light with Lux meter	
4.	Study of characteristics such as operating voltage, efficacy, starting time, restarting time, colour appearance, colour rendering effect, effect of voltage variation on the performance of different lamps.	
5.	Study of Induction Furnace by visiting a factory and to prepare a Report.	
6.	Study of Arc Welding Equipment along with its accessories.	
7.	Study of Resistance Welding equipment with its accessories.	
8.	Study of an Electric Locomotive.	
9.	To trace the Circuit Diagram of Electric Oven and troubleshoot for Faults.	
10.	To calculate heating Efficiency of Electric Kettle/Immersion Heater.	
	Total	**25**

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	J. B. Gupta	Electrical Installation Estimation & costing	S. K. Kataria &Sons
2	V. K. Mehta	Power system	S. Chand
3	V. K. Jain	Bulk Electric supply and distribution	
4	J. B. Gupta	Utilization of Electrical Power & Electric Traction	S.K. Kataria & Sons
5	G. C. Garg, S. K. Girdhar, S. M. Dhir	A Course in Utilisation of Electrical Energy	Khanna Publication

Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	J.B. Gupta	A Course in Electrical Power	S. K. Kataria &Sons
2	A.S. Pabla	Electrical Power distribution	Tata Mc Graw
3	R. K. Rajput	Utilization of Electrical Power	Laxmi Publication
4.	Tarlok Singh	Utilization of Electrical Energy	S.K. Kataria & Sons

(CC307) ELEMENTS OF MECHANICAL ENGINEERING

1. COURSE OBJECTIVES

This course will help students to acquire a basic knowledge about mechanical engineering with respect to mechanical elements, mechanical power transmission devices, engines, machinery so as to enable him to do basic job of operation and maintenance in Industries

2. TEACHING AND EXAMINATION SCHEME

Semester	**IV**								
Course code & course title		**Periods/Week (in hours)**			**Total Hours**	**Examination Scheme**			
						Theory Marks		**Practical Marks**		**Total Marks**
(CC307) ELEMENTS OF MECHANICAL ENGG.		**L**	**T**	**P**	**H**	**TH**	**TM**	**TW**	**PR/OR**	
		3	**-**	**2**	**5**	**75**	**25**	**25**	**-**	**125**

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

CC307.CO1: Explain power transmission devices, parts of I.C. engines, boilers, pumps and refrigeration equipments

CC307.CO2: Identify various parts and uses of I.C. engines, boilers accessories and refrigeration components

CC307.CO3: Distinguish between various types of I.C. engines, boilers and pumps

CC307.CO4: Discuss the application of various types of lubricants, maintenance tools, couplings and bearings.

4. MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation& Testing	Engg. Practices for Society ,Sustainability & Environment	Project Management	Life -long Learning
CC307.CO1	2	1	-	3	-	3	2
CC307.CO2	2	1	-	1	-	3	2
CC307.CO3	2	3	2	-	-	3	2
CC307.CO4	3	3	3	3	3	3	3

Relationship : Low-1 Medium-2 High-3

	PSO1	PSO2
CC307.CO1	2	1
CC307.CO2	1	-
CC307.CO3	1	-
CC307.CO4	2	1

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks | **Thr = Teaching hours** | **CO = Course Objectives**			
Unit	**M**	**Thr**	**CO**
1 MECHANICAL POWER TRANSMISSION	**15**	**8**	**CO1, CO4**
1.1 Belt drives – classification & applications Chain drives – Power transmitting chains (Block chain, Bush roller chain) and their applications. Gear drives –Spur, Helical & Bevel gear drives and their applications Gear trains (simple & compound only) and their speed ratio.			
1.2 Couplings – rigid coupling (marine type only), flexible coupling (bush pin type only) Bearings – Definition & function of bearings, rolling and sliding contact bearings (their functions and applications.)			
2 I.C. ENGINES	**18**	**12**	**CO1, CO2, CO3**
2.1 Introduction, classification & basic engine components.			
2.2 Construction and working of 4 stroke and 2 stroke engines (petrol & diesel). Difference between petrol and diesel engines. Difference between 2 stroke and 4 stroke engines. Technical terms of I.C. engines – Stroke volume, Compression ratio, Brake power.			
3 THERMAL ENGINEERING EQUIPMENTS & PUMPS	**21**	**14**	**CO1, CO2, CO3**
3.1 Introduction. Basic components of a thermal power station and their function (Condenser, Turbine, Boiler).			
3.2 Boiler – Introduction, function, classification (water tube, fire tube), Construction and working of Babcock & Wilcox boiler and Cochran boiler. Comparison between fire tube and water tube boiler. Boiler mountings and accessories like-, water level indicator, and super heater. Awareness to Indian Boiler Regulations i.e. IBR (Brief Introduction)			
3.3 Introduction, working principle, classification. Centrifugal and reciprocating pump -construction & working. Comparison between Centrifugal pump & Reciprocating pump. Technical specifications - power, discharge, head.			
4. REFRIGERATION & AIR CONDITIONING	**12**	**7**	**CO1, CO2**
4.1 Introduction, unit of refrigeration (Ton), COP, Working and operation of simple vapour compression system (p-h & t-s diagrams to be excluded).			
4.2 Air Conditioning- definition, working of Window and split Air conditioner			
5. MAINTENANCE ENGINEERING	**9**	**7**	CO1, CO4
5.1 Definition, types -preventive, breakdown and predictive maintenance. Necessity of lubrication. Common types of lubricants. Methods of lubrication – wick/drip type, grease gun, grease cup.			
5.2 Maintenance tools and their functions (no construction & working) – spanners (open end & ring type), screw jack, gauges, screw driver, torque wrench, allen key, chain pulley block.			
Total	**75**	**48**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	Number of lectures	Marks
1	MECHANICAL POWER TRANSMISSION	08	15
2	I.C. ENGINES	12	18
3	THERMAL ENGINEERING EQUIPMENTS & PUMPS	14	21
4	REFRIGERATION & AIR CONDITIONING	07	12
5	MAINTENANCE ENGINEERING	07	09
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK

No	Practical	Marks
1.	Study of different types of gears.	
2.	Removal and mounting of belt. Checking tension in the belt.	
3.	Demonstration of mounting and removal of ball/roller bearing., Knowing its bearing number	
4.	Study of petrol/diesel engine construction.	
5.	Study of petrol/diesel engine working.	
6.	Study of water tube and fire tube boiler (Babcock & Wilcox and Cochran).	
7.	Study of any one refrigeration Air conditioning equipment , method of installation for AC	
8.	Study of centrifugal and reciprocating pumps and common faults in pumps with their troubleshooting	
9.	Literature survey and seminar (A brief power point presentation of around 15 min on any topic relevant to mechanical engineering). It may be done individually or in groups depending on class strength.	
	Total	25

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	R.S. Khurmi	Theory of Machines	
2	R.S. Khurmi	Thermal Engineering	S. Chand
3	R.K. Rajput	Textbook of Hydraulic Machines	Laxmi
4	R.K. Rajput	Refrigeration & Air Conditioning	Laxmi
5	S.N. Bhattacharya	Installation, Servicing & Maintenance	S. Chand

SEMESTER V

(EL501) SWITCHGEAR AND PROTECTION

1. COURSE OBJECTIVES

This course enables the students to acquire knowledge about the principles and working of various switching and protective devices and understand the practices followed in protection schemes employed in electrical power systems.

2. TEACHING AND EXAMINATION SCHEME

Semester	**V**								
Course code & course title		**Periods/Week (in hours)**			**Total Hours**	**Examination Scheme**			
						Theory Marks		**Practical Marks**		**Total Marks**
(EL501) Switchgear & Protection		L	T	P	H	TH	TM	TW	PR/OR	
		4	-	-	4	75	25	-	-	100

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

EL501.CO1: Explain various terms and principle of working of switching and protective devices.
EL501.CO2: Demonstrate the construction and operation of various switching and protective devices.
EL501.CO3: Compare different protective devices and faults.
EL501.CO4: Choose a protective system for a particular application.

4. MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation & Testing	Engg. Practices for Society, Sustainability	Project Management	Life -long Learning
EL501.CO1	3	3	2	1	2	2	2
EL501.CO2	3	3	2	2	2	3	2
EL501.CO3	3	3	2	1	1	2	3
EL501.CO4	3	3	2	2	2	3	3

Relationship : Low-1 Medium-2 High-3

	PSO1	PSO2
EL501.CO1	1	-
EL501.CO2	2	1
EL501.CO3	1	-
EL501.CO4	3	2

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	**Thr = Teaching hours**	**CO = Course Objectives**		
Unit		**M**	**Thr**	**CO**
1. FAULTS		**9**	**8**	CO1,CO3
1.1 Nature & causes of faults, consequences of short circuit fault. Symmetrical faults & unsymmetrical faults. Concept of current reactor & its classification based on location.				
1.2 Calculation of short circuit MVA & current for symmetrical faults using per unit method.				
2. FUSES		**9**	**6**	CO1,CO2, CO3,CO4
2.1 Definition, advantages and disadvantages of fuses. Desirable characteristics of fuse elements. Terms related to fuses: current rating, fusing current, fusing factor, pre arcing time, cutoff current, arcing time, total operating time and breaking capacity.				
2.2 Types of fuses; LV fuses, (Re wirable or kit kat fuse), HRC Fuse. (Working & construction). Comparison between rewirable & HRC fuse.				
3. CIRCUIT BREAKERS		**24**	**20**	CO1,CO2, CO3,CO4
3.1 Main function of circuit breaker Arc phenomena, (Initiation and maintenance of arc), Method of arc extinction (High resistance methods and low resistance or current zero method) Circuit breaker rating(rated voltage, rated current, rated frequency, operating duty, breaking capacity, making capacity), General specifications for procurements. Definition: Arc voltage, restriking voltage, recovery voltage, RRR				
3.2 Basic principles of operation and constructional features of MCB, MCCB, ELCB.				
3.3 Constructional features(with respect to arc extinction only), and working of air circuit breaker, Air Blast Circuit Breaker, minimum oil circuit breakers(Types of arc control devices), SF6 circuit breaker(puffer piston type only), vacuum circuit breaker. Difference between fuse and circuit breakers. Concept of HVDC circuit breaker				

4 RELAYS	**18**	**16**	CO1,CO2, CO3,CO4
4.1 Definitions: Relay, Pick up, reset. Fundamental requirements of protective relay, classification of relay – Electromagnetic attraction type & Induction type, Static type, Numeric type.			
4.2 Construction and working of 1.Bucholz relay, 2. Bi metallic relay (basic concept) 3. Attraction type relay (hinged armature type & solenoid & Plunger type) 4. Induction relay,(shaded pole structure) 5. Induction type IDMT relay, Reverse Power Relay, Concept of TSM & PSM in IDMT relay (No Numericals)			
4.3 Static relay: Introduction advantages and block diagram for over current and differential protection.			
5 PROTECTIVE SCHEMES	**15**	**14**	CO1,CO2, CO4
5.1 Concept of Main & Back up protection, Differential Protection, biased differential protection. Protection of three phase induction motors: Combined earth fault & over current protection for stator winding, single phasing protection. Transformer protection: biased differential protection for transformer, (connection of CT's) 5.2Bus bar Protection: Differential protection and earth leakage protection. Protection of transmission lines: concept of distance protection, Time graded and current graded (only for radial feeders)			
Total	**75**	**64**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	Number of lectures	Marks
1	FAULTS	8	9
2	FUSES	6	9
3	CIRCUIT BREAKERS	20	24
4	RELAYS	16	18
5	PROTECTIVE SCHEMES	14	15
	Total	64	75

8. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	J. B. Gupta	Switchgear & Protection	S. K. Khataria & Sons
2	V. K. Mehta	Principles of power systems	S Chand
3	Sunil S. Rao	Switchgear & Protection	Prentice Hall of India

(EL502) POWER ELECTRONICS AND DRIVES CONTROL

1. COURSE OBJECTIVES

This subject enables the students to extend the application of semiconductor devices to circuits that are rated at power level. Students will understand the applications of power semiconductor devices. Essential theoretical and practical knowledge to use power electronics to control electrical machines in commercial and industrial sector will be achieved by this course.

2. TEACHING AND EXAMINATION SCHEME

Semester	**V**								
Course code & course title		**Periods/Week (in hours)**			**Total Hours**	**Examination Scheme**			
						Theory Marks		**Practical Marks**	**Total Marks**
(EL502)		**L**	**T**	**P**	**H**	**TH**	**TM**	**TW**	**PR/OR**	
Power Electronics & Drives Control		**4**	**-**	**2**	**6**	**75**	**25**	**25**	**-**	**125**

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

EL502.CO1: Explain the working of power electronic devices.
EL502.CO2: Demonstrate the applications of power electronics.
EL502.CO3: Analyze the working of power electronic circuits.
EL502.CO4: Interpret the use of power electronic circuits for electrical drives control.

4. MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation & Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
EL502.CO1	3	2	1	1	1	1	2
EL502.CO2	3	3	3	3	1	2	2
EL502.CO3	3	3	3	2	1	2	2
EL502.CO4	3	3	3	3	2	2	2

Relationship : Low-1 Medium-2 High-3

	PSO1	PSO2
EL502.CO1	2	2
EL502.CO2	3	3
EL502.CO3	3	3
EL502.CO4	3	3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	**Thr = Teaching hours**

Unit	**M**	**Thr**	**CO**
1.POWER ELECTRONIC DEVICES	**15**	**13**	**CO1,CO3**
1.1 Introduction to Power Electronics. Power electronic devices- SCR, DIAC, TRIAC, IGBT, GTO, POWER MOSFET (symbols, function and application only)			
1.2 SCR-Construction, symbol, V-I characteristics (Reverse blocking mode, forward blocking mode, forward conduction mode, latching and holding current), two transistor model of thyristors. Turn ON methods –Forward voltage triggering, gate triggering (pulse triggering using UJT), thermal triggering. Commutation in SCR- types of commutations- Natural & Forced (A, B, C& D Type Only) Protection Circuits: di/dt protection, Snubber circuits (dv/dt protection).			
2. CONVERTERS & AC VOLTAGE CONTROLLERS	**15**	**13**	**CO2,CO3**
2.1Working principle of phase controlled convertor-Single phase Half wave (with R and RL Load), single phase full wave bridge type and single phase dual converter with RL Load. (Only circuit diagram, operation and waveforms).Concept of Freewheeling diode. Three phase - Full wave & Dual converter. (Only circuit diagram and waveforms in each case).			
2.2 AC Voltage Controllers: Principle of operation – ON-OFF control and Phase control. Single phase full wave controller with R and RL Load (no derivation).			
3. CYCLOCONVERTERS & REGULATORS	**12**	**11**	CO2, CO3
3.1 Operating principles of Cycloconverter, types: single phase to single phase, F/2& F/3 generating			

Cycloconverter with center tapped configuration.			
3.2 Block diagram of SMPS-Circuit diagram & working of - Buck regulator, Boost regulator & Buck Boost regulator.			
4. CHOPPERS & INVERTERS	**12**	**11**	CO2,CO3
4.1 Choppers-Definition, circuit, working, waveforms of chopper: First quadrant (class A), Second quadrant (class B), First and Second Quadrant (Class C).			
4.2 Inverters- Circuit, working, waveforms of inverter: Basic Series Inverter, Modified series inverter, Parallel inverter, single phase full wave bridge inverter.			
5. DC & AC MOTOR DRIVES CONTROL	**21**	**16**	CO2,CO3, CO4
5.1. Concept and Block diagram of an electric drive system using power electronic converter. Circuit and working of single phase DC drives for separately excited motors- single phase full converter drive, single phase dual converter drive. Three phase full converter drive, three phase dual converter drive Two quadrant chopper drive, Four Quadrant chopper drive.			
5.2. Circuit diagram, working and applications of Stator voltage control, Static Rotor Resistance Control using chopper, Static Scherbius drive and Static Kramer's drive. Schematic diagram and working of VFD.			
TOTAL	**75**	**64**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies.

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	Number of lectures	Marks
1	POWER ELECTRONIC DEVICES	13	15
2	CONVERTERS AND AC VOLTAGE CONTROLLER	13	15
3	CYCLOCONVERTERS & REGULATORS	11	12
4	CHOPPERS & INVERTERS	11	12
5	DC & AC MOTOR DRIVES CONTROL	16	21
	Total	64	75

8. SPECIFICATION TABLE FOR TERM WORK

No	Practical (Any 8)	Marks
1.	To study the Volt ampere characteristics of SCR	
2.	To study V-I characteristics of UJT	
3.	To study characteristics of TRIAC & DIAC	
4	To study UJT Triggering of SCR	
5	Study of Cycloconverter	
6.	Study of SCR series inverter	
7.	Study of chopper circuit	
8.	Study of light dimmer	
9.	Study of dv/dt triggering	
10.	Study of speed control of D.C. motor using SCR.	
11.	Study of V/F control scheme for three phase Induction motor.	
		25

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	M.H. Rasheed	Power Electronics	Pearson
2	P.S Bhimbra	Power Electronics	Khanna Publishers
3	Bimal K. Bose	Modern Power Electronics & AC Drives	Prentice Hall India
4	Alok Jain	Power Electronics	Pernam International

Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	S.K. Bhattacharya	Industrial Electronic Drives & Control	Tata Mc Graw Hill
2	P.C. Sen	Modern Power Electronics	S Chand
3	Daniel W. Hart	Power Electronics	Mc Graw Hill

(CC602) BUSINESS COMMUNICATION

1. COURSE OBJECTIVES:

The students will able to:

1. Use speaking, writing and presentation skills to communicate effectively.
2. Develop business etiquettes, manners, grooming and improve personal appearance
3. Improve non verbal forms of communication.

2. TEACHING AND EXAMINATION SCHEME

Semester	**V**								
Course code & course title		**Periods/Week (in hours)**			**Total Hours**	**Examination Scheme**			
						Theory Marks		**Practical Marks**	**Total Marks**
(CC602) Business Communication		L	T	P	H	TH	TM	TW PR/OR	
		-	-	2	2	-	-	25 25	50

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

CC602.CO1: Understand the principles of effective communication

CC602.CO2: Use the principles of communication effectively in the corporate environment

CC602.CO3: Analyse and organize information for effective communication

CC602.CO4: Develop soft skills in order to adapt to the changing and competitive corporate work environment.

4. MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation& Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
CC602. CO1	1	0	1	0	1	2	2
CC602. CO2	2	2	2	1	2	2	3
CC602. CO3	2	2	2	1	2	2	3
CC602. CO4	1	1	1	1	2	3	3

Relationship : Low-1 Medium-2 High-3

	PSO1	PSO2
CC602.CO1	1	2
CC602.CO2	2	2
CC602.CO3	2	2
CC602.CO4	3	3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	**Thr = Teaching hours**	**CO = Course Objectives**		
Unit			**M**	**Thr**	**CO**
1 COMMUNICATION SKILLS AT WORKPLACE				**04**	**CO1,CO2, CO3,CO4**
1.1 **Principles of communication in business** Importance of communication in a business organization, types of communication(formal and informal Internal and External Communication), Channels of communication: Vertical, Horizontal, Diagonal, Grapevine					
1.2 **Modern Office technology for communication**: email communication and sending text (etiquettes, components, tips for writing effective emails, spell check) ,internet and use of social media for work (to communicate, search for information about suppliers, specifications, networking, quick feedback ,e-commerce, video conferencing)					
2 SEMINARS				06	**CO1,CO2, CO3,CO4**
2.1 **Organization of seminars and workshops** Organizers role: planning, objectives, topic selection, planning the date ,time ,venue , creating event organization material : creating facebook page ,WatsApp group, invitations , advertisement on pamphlet , hand-outs ,signage ,name badges, registration form, press note, inviting key note speaker, schedule					
2.2 **Presentation** Speakers role: Gathering relevant material, organization of the material, knowing the occasion and audience, preparing handouts for distribution, time management, interaction with audience, non verbal communication. (Checklist of significant aspects of oral presentation to be provided)					
2.3 Role of audience Audience's role: Listening effectively and asking relevant questions, note taking					
3 TECHNICAL WRITING				10	**CO1,CO2, CO3,CO4**
3.1 Reports					

Understanding objective report writing, types of reports, parts of a formal report, illustrations inspection reports: procedure and format ,Project Report			
3.2 Business letters Sales letters : parts of sales letter complaint letters: elements of a complaint letter adjustment letters: elements of an adjustment letter			
3.3 Tenders procedure, Preparation, Types of tenders, Single tender, limited tender, Open tenders, government e tender, structure of a tender document, tender notice, terms and conditions, payment details, specification, documents to be submitted, drafting advertisement for tender. 3.4 Generic notices, notice for meetings :purpose, format of notice for meeting, agenda , quorum and writing minutes			
4 JOB INTERVIEWS		06	**CO1,CO2, CO3,CO4**
4.1 Job application and resume draft job application and resume, draft letter of acceptance and cold contact letter			
4. 2 Job interviews preparing for job interview, guidelines on facing job interviews, mock interviews			
5 SOFT SKILLS 5.1 Business etiquettes Importance of business etiquettes and manners, Tips for good business etiquettes		06	
5.2 Non verbal Communication grooming, personal appearance, hygiene, deportment and body language 5.3 Interpersonal skills Leadership skills, team work , active listening 5.4 Critical thinking How to improve critical thinking, tips for critical thinking			
Total	**50**	**32**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	Number of HOURS	Marks
1	COMMUNICATION AT WORKPLACE	04	
2	SEMINARS	06	
3	TECHNICAL WRITING	10	
4	JOB INTERVIEWS	06	
5	SOFT SKILLS	06	
	Total	32	50

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	Practical	Marks 50
	Practical Title	
1.	Modern office technology	
2.	Seminar	
3.	Technical writing	
4.	Job interviews	
5	Soft skills	
No	**Class room Assignments**	
1	Email communication	
2	Power point presentation	
3.	drafting seminar invites	
4.	Drafting hand outs for seminars	
5	Drafting sales letter	
6	Drafting complaint letters	
7	Drafting adjustment letters	
8	Drafting tender notice	
9.	Filling maintenance reports	
10.	Drafting inspection reports	
11	Drafting abstract	
12	Drafting notice for meetings	
13	Drafting agenda of meetings	
14	Drafting minutes of meeting	
15	Drafting resume and job application	
16	Drafting letter of acceptance	
17	Drafting cold contact cover letter	
18	Group discussions	
19	Debates	
20	Group presentations	

9. LEARNING RESOURCES

Reference books

S. No.	Author	Title of Books	Publishers
1	P. Prasad, Rajendra k. Sharma	The functional aspects of communication skills	s. k. kataria &sons
2	Pal & Rorualling	Essentials of business communication	Sultan chand & sons
3	Grount Taylor	English conversation practice	Tata MCgraw Hill
4	R.C. Sharma & Krishna Mohan	Business Correspondence & report writing	Tata MCgraw Hill

(TR 501) INDUSTRIAL TRAINING

1. COURSE OBJECTIVES

To expose & prepare the students for the Industrial work situation. This exposure and hands on experience will further enhance the prospects of student fraternity to be better placed on completion of their course.

2. TEACHING AND EXAMINATION SCHEME

Semester	V									
Course code & course title		Periods/Week (in hours)			Total Hours	Examination Scheme				
						Theory Marks		Practical Marks		Total Marks
(TR 501) Industrial Training		L	T	P	H	TH	TM	TW	PR/OR	
		-	-	4	4	-	-	70	30	Grade

08 Weeks

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

TR501.CO1: Understand the organizational set up & functions of various departments in the industry

TR501.CO2: Apply the knowledge gained in the institute to correlate with the actual processes in the industry & Compile relevant data in the form of a report.

TR501.CO3: Survey industrial process, identify problems, take it up as project and recommend solutions for improvement

TR501.CO4: Develop leadership, teamwork, communication skills and consciousness towards safety & environment by adapting to the rules & regulations of Industry

4. MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation & Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
TR501.CO1	1	1	1	1	2	2	1
TR501.CO2	3	3	3	3	2	3	3
TR501.CO3	3	3	3	3	3	3	3
TR501.CO4	2	3	1	3	3	3	3

Relationship : Low-1 Medium-2 High-3

	PSO1	PSO2
TR501.CO1	1	-
TR501.CO2	3	1
TR501.CO3	3	2
TR501.CO4	2	1

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

1.1 Students are required to study and have hands-on experience wherever possible in the following areas (depending on availability):

- Company Profile
- Organizational Structure
- Company Product Range
- Manufacturing Facilities Available /Services provided
- Plant / Facility Layout
- Operations / Production Processes
- Production Planning and Control
- Detail study of Latest Equipment/ Technologies Used
- Stores Functions
- Material Handling Systems/ Equipments
- Quality Management Systems / Functions
- Maintenance and Repair Practices
- Safety Practices / Safety Equipments
- Utilities
- Logistics
- Sales and Marketing
- Ethics, Statutory Rules and Regulations followed
- Product Design and Development
- Any other area specific to the Industry providing Training

6. TERM WORK & PRACTICALS

Evaluation Scheme					
TW				PR/OR	
Attendance Marks*	Industrial Mentor's assessment Marks	Institute Mentor's assessment Marks	Training Report	Report Assessment & Seminar/Viva	TOTAL Marks
10	20	20	20	30	100

* 01 mark shall be deducted for every Absence (with or without permission).

Daily Diary:

The daily dairy should-be maintained in a book. It should reflect the day to day activities performed by the student (including task, men and materials involved). It should be counter signed by the Industry Mentor. It will become the basis for writing reports on the complete training.

Training Report

The training report should be submitted by the training students should include the following salient points- Certificate from institute, Certificate of training from company, detailed write up as per daily dairy, detailed drawings, working drawings, photographs, safety precautions, techniques for work minimization on site, organizational chart, Importance of project to the society, special methods/techniques/equipment should be separately high lightened, including environmental aspects. The report should be informative and technical, typed with double spacing on good quality bond paper and bound. Assessment of Training Report be based on Knowledge, Presentation, Quality of contents and Sketches.

Note:

a. Student/s undergoing Industrial Training shall follow Rules and Regulations of the Industry.
b. Industrial Training will generally be organized and conducted in accordance with IndustrialTraining Manual duly prescribed by the Board.

7. SUGGESTED SPECIFICATION TABLE WITH MARKS & HOURS

Unit No	Name of the Unit	Teaching Hours	Marks
1	PR/OR	08 weeks	30
2	TW		70
	Total	08 weeks	100

Note:

1. For Industrial training Grades will be awarded based on marks scored as follows:80%

   and above Marks – Grade 'A'
   60% to 79% Marks – Grade 'B'
   40% to 59% Marks – Grade 'C'
   Marks below 40% - Grade 'D'

2. TW and PR/OR shall be separate heads of passing. Student has to secure minimum Grade 'C' forpassing.

AUDIT COURSE

(AC101) ESSENCE OF INDIAN KNOWLEDGE AND TRADITION

1. COURSE OBJECTIVES:

This course aims at imparting basic principles of thought process, reasoning and inferencing by human being. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature. Holistic life style of Yogis, science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. The course thus focuses on introduction to Indian Knowledge System, Indian perspective of modern scientific world-view, basic principles of Yoga and holistic health care system.

2. TEACHING AND EXAMINATION SCHEME

Semester	V									
Course code & course title	Periods/Week (in hours)			Total Hours	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
(AC101) Essence of Indian Knowledge and Tradition	L	T	P	H	TH	TM	TW	PR/OR	
	2	-	-	2	-	-	-	-	-

Course Content:

Basic Structure of Indian Knowledge System:
(i) `5, (ii) 7! `5(`5, ग `5, ग `5, 3 T!w 55) (iii) `5T ा ग(ि T, ढ़ं, गग U, DT ₹ , गU ा5), (iv) 7!ाहग(ि T ,₹ ₹ T ा T, !₹T , U ि T)
- Modern Science and Indian Knowledge System
- Yoga and Holistic Health care
- Case Studies.

S. No.	Title of Book	Author	Publication
1.	Cultural Heritage of India- Course Material	V. Sivaramakrishna	Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014
2.	Modern Physics and Vedant	Swami Jitatmanand	Bharatiya Vidya Bhavan
3.	The wave of Life	Fritzof Capra	
4.	Tao of Physics	Fritzof Capra	
5.	Tarkasangraha of Annam Bhatta, Inernational	V N Jha	Chinmay Foundation, Velliarnad, Amaku,am
6.	Science of Consciousness Psychotherapy and Yoga Practices	RN Jha	Vidyanidhi Prakasham, Delhi, 2016

ELECTIVE I

(EL628) ELECTRICAL LAYOUTS AND ESTIMATION

1. COURSE OBJECTIVES

This course will enable the students to know facts, procedures, IE rules and standard practices related to distribution of power in a locality, domestic and industrial installations. The students will acquire the knowledge of planning, drawing of layout and estimation of quantity of material for a given installation.

2. TEACHING AND EXAMINATION SCHEME

Semester	**V**								
Course code & course title		**Periods/Week (in hours)**			**Total Hours**	**Examination Scheme**			
						Theory Marks		**Practical Marks**		**Total Marks**
(EL628) Electrical Layout and Estimation		L	T	P	H	TH	TM	TW	PR/OR	
		3	-	2	5	75	25	25	25	150

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:
EL628.CO1: Explain distribution and wiring systems.
EL628.CO2: Develop appropriate layouts for distribution system, domestic and industrial installations.
EL628.CO3: Analyze performance of distribution system.
EL628.CO4: Estimate wiring material required for domestic and industrial installation.

4. MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation & Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
EL628.CO1	3	3	3	1	3	3	3
EL628.CO2	3	3	3	3	3	3	3
EL628.CO3	3	2	2	-	-	-	-
EL628.CO4	3	3	3	1	3	3	3

Relationship : Low-1 Medium-2 High-3

	PSO1	PSO2
EL628.CO1	2	-
EL628.CO2	3	2
EL628.CO3	3	2
EL628.CO4	3	-

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	**Thr = Teaching hours**	**CO = Course Objectives**			
Unit			**M**	**Thr**	**CO**
1. ESTIMATION OF OVERHEAD DISTRIBUTION SYSTEM			**24**	**15**	**CO1, CO2, CO3**
1.1 Components used in 11KV and LT 440V distribution lines & their functions: List of Poles and their fittings ,list of conductors and their accessories, earth wire and its accessories, list of insulators and their fittings, anti-climbing devices and danger sign boards. Stay set and their parts (single stay and double stay arrangement), factors to be considered for selection of number of stay sets for LT/11 KV overhead distribution system. Guarding of overhead lines-cradle and cage type.					
1.2 Design Of LT AC Distributor: Calculation of inductive reactance and resistance of line (no derivation) Calculation of voltage drop using impedance method for: 1) Radial distributors fed from one end - when power factors is referred to receiving end and when power factor is referred to respective load points. 2) Ring distributors.					
1.3 Layout and estimation of 440V and 11KV lines: Layout of LT distribution line (3 Phase 4 wire, 440 volts) and 11KV feeder indicating pole position, stay set position and earth electrodes. Estimation of materials required for 3 Phase 4 wire, 440 volts LT line & 11KV A.C. radial distribution line. Estimation of capacity of distribution transformer for particular locality.					
2. WIRING SYSTEM			**15**	**10**	**CO1, CO2**
2.1 Domestic wiring system Underground & overhead service connections, Block diagram of meter distribution board. Simple wiring diagram of a single phase installations showing the					

electrical connection of the main components (cut out, energy meter, main switch, distribution box and sub-circuits). Simple wiring diagram for three phase 4 wire distribution for single and three phase loads with separate sub distribution boards (cut out, energy meter, main switch, distribution board and sub circuit). Systems of Wiring – Brief explanation of PVC casing capping, surface & concealed conduit wiring. Lighting sub circuits: T system, Loop in system, advantages and disadvantages. Basic schematic & wiring diagrams for lighting sub circuits (lamps, fans, sockets), staircase wiring, Godown wiring, Difference between neutral and earth wire.			
2.2 Testing of wiring installations: Insulation Resistance test between conductor and earth, between conductors. Testing of polarity of switches, Earth continuity test.			
3. ESTIMATION OF DOMESTIC WIRING	**15**	**9**	**CO 1, CO2, CO4**
3.1Standard practices relevant to light & fan wiring and power wiring Domestic wiring estimation-Planning layout, wiring diagram and estimation of quantity of materials for domestic installation. Load calculations. Selection of rating of cables and switch gear, number of light and fan sub circuits and earth wiring. Draw the layout, wiring diagram and estimate the quantity of materials required.			
3.2Estimation of energy bill for domestic installations using block rate tariff.			
4. INDUSTRIAL WIRING	**12**	**9**	**CO1, CO2, CO4**
4.1 Methods of wiring in industrial installations:- Cable system and Bus way system (overhead). Important considerations regarding motor installations, Planning and layout of industrial switch boards and panels for industrial wiring-determination of ratings of cables, determination of rating of fuses Calculation of main switch rating, calculation of individual switch ratings, and selection of starters.			
4.2 Drawing the Layout, single line diagram, wiring diagram of electrical installation for motors in small scale industry.(restricted to maximum two motors only) Estimation of energy bill for industrial installations using maximum demand and power factor tariff.			

5 LAYOUT OF PANEL BOARDS	**9**	**5**	**CO1, CO2, CO4**
Types of panel boards, Design conditions (Layout Practices), Layout of panel board for light and fan circuits.			
Total	**75**	**48**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	Number of lectures	Marks
1	ESTIMATION OF OVERHEAD DISTRIBUTION SYSTEM	15	24
2	WIRING SYSTEM	10	15
3	ESTIMATION OF DOMESTIC WIRING	9	15
4	INDUSTRIAL WIRING	9	12
5	LAYOUT OF PANEL BOARDS	5	9
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK

No	Practical (Minimum 8)	Marks
1.	Estimate the material list for 11KV LT distribution system	
2	Practice of simple wiring – wiring of fan, lamp and socket.	
3	Practice of staircase wiring.	
4	Practice of godown wiring.	
5	Testing of wiring installation.	
6	Planning, layout and estimation of cost of wiring for a small residential premise.	
7	Visit to small scale industry to study the wiring system and prepare a report on same.	
8	Planning, layout and estimation of cost of wiring for a small electrical workshop	
9	Study of load dispatch centre	
	Marks	**25**

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	J. B. Gupta	Electrical Installation Estimation & costing	S. K. Kataria &Sons
2	Raina , Bhattacharya	Electrical Design Estimating & costing	New Age International publishers

Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	J.B. Gupta	A Course in Electrical Power	S. K. Kataria &Sons
2	Arora	A handbook of electrical wiring and estimation costing	R. B. Sales corporation
3	V. K. Jain	Bulk electrical supply and distribution	Galgotia Book source

(EL629) SOLAR AND WIND ENERGY SYSTEM

1. COURSE OBJECTIVES

The course content enables students to understand the necessity of exploring renewable energy sources such as solar and wind energy and will create awareness about utilization of such energy sources for different applications.

2. TEACHING AND EXAMINATION SCHEME

Semester	**V**								
Course code & course title		**Periods/Week (in hours)**			**Total Hours**	**Examination Scheme**			
						Theory Marks		**Practical Marks**		**Total Marks**
(EL629) Solar and Wind Energy System		L	T	P	H	TH	TM	TW	PR/OR	
		3	-	2	5	75	25	25	25	150

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

EL629.CO1: Explain the functions and significance of various components related to solar and wind energy conversion system.
EL629.CO2: Demonstrate the operation of various applications of solar and wind energy.
EL629.CO3: Analyze the performance of solar photovoltaic system and wind energy system.
EL629.CO4: Design solar photovoltaic system for given application.

4. MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation& Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
EL629.CO1	3	3	2	2	3	3	2
EL629.CO2	3	3	2	3	3	3	3
EL629.CO3	3	3	3	3	2	2	2
EL629.CO4	3	3	2	1	3	2	3

Relationship : Low-1 Medium-2 High-3

	PSO1	PSO2
EL629.CO1	1	1
EL629.CO2	2	1
EL629.CO3	3	1
EL629.CO4	3	2

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks | **Thr = Teaching hours** | **CO = Course Objectives**			
Unit	**M**	**Thr**	**CO**
1. SOLAR ENERGY OPTION AND ITS APPLICATIONS	18	12	CO1, CO2
1.1 Solar energy option, its advantages and limitations, solar radiation at earth surface Principle of solar thermal conversion, Solar collectors: non concentrating collector : Liquid Collector concentrating collector: Line focusing and Point focusing collectors			
1.2 Necessity of solar energy storage -Battery storage			
1.3 Applications of solar energy : Construction & working and of Solar water heater, Solar Distillation, Solar pumping, Solar furnace, Solar cooking.			
2. SOLAR PHOTOVOLTAIC CONVERSION	21	14	CO1, CO2,CO3, CO4
2.1 Photovoltaic power conversion, Solar cell technology			
2.2 Equivalent circuit, characteristics of solar cell. Losses and efficiency of solar cell, factors affecting efficiency of solar cell. Solar PV module: Series and parallel connection of solar cells, maximum power point tracking concept			
2.3 Application of PV system: Stand alone PV system, PV system with battery storage for AC/DC load, grid connected PV system Design of PV system for standalone domestic load, pumping system			
3. WIND ENERGY OPTION	15	10	CO1, CO2
3.1 Generation of wind, site selection for wind energy conversion system, advantages and limitations of wind energy			
3.2 Basic component of wind energy conversion system, Physical embodiment of wind electric generating station, classification of wind energy conversion system Types of wind turbine :Horizontal axis wind turbine: propeller type Vertical axis wind turbine (brief explanation) List of generator for wind energy conversion system			

4. FEATURES AND APPLICATIONS OF WIND ENERGY	15	08	CO1, CO2, CO3
4.1 Power- speed characteristics, torque speed characteristics Wind turbine control system :Pitch control, stall control, yaw control (brief explanation)			
4.2 Application of wind energy : Electricity generation, wind assisted gas turbine generating unit, pumping			
4.3 Environmental aspects of wind energy conversion system			
5. HYBRID SYSTEM	06	04	CO1, CO2
5.1Necessity of hybrid system Wind – Diesel hybrid system with & without storage Wind – Photovoltaic system			
Total	**75**	**48**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	**Unit**	**Number of lectures**	**Marks**
1	SOLAR ENERGY OPTION AND ITS APPLICATIONS	12	18
2	SOLAR PHOTOVOLTAIC CONVERSION	14	21
3	WIND ENERGY OPTION	10	15
4	FEATURES AND APPLICATIONS OF WIND ENERGY	08	15
5	HYBRID SYSTEM	04	06
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK

No	Practical (Minimum Eight)	Marks
1.	Study of different types of PV panel	
2.	To plot I V characteristics of solar module	
3.	To plot I V characteristics of series connected PV modules	
4.	To plot IV characteristics of parallel connected PV modules	
5.	Performance assessment of PV system supplying DC load	
6.	Performance assessment of PV system supplying AC load	
7.	Study of construction and working of solar water heater, solar cooker	
8.	Design of PV system for a given application	
9.	Study of different types of wind turbine	
10.	Field visit/case study of Wind – Photovoltaic hybrid system	
11.	Study of operation of wind and solar radiation measuring instruments	
12.	Case Study of wind speed and solar radiation statistics for a given location	
	Total	25

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	G. D. Rai	Non conventional energy sources	Khanna publishers
2	S. N. Bhadra, D. Kashtha, S. Banerjee	Wind electrical system	Oxford university press
3	S. P. Sukhatme	Solar energy principle of thermal collector and storage	Tata Mcgraw Hill
4	John Twidell and Tony Weir	Renewable energy resources	Routledge
5	Chetan Singh Solanki	Solar Photovoltaic Technology and systems	

(EL632) ELECTRICAL SAFETY MANAGEMENT

1. COURSE OBJECTIVES

The course will enable the learner to understand various safety aspects with respect to electrical systems including first aid ,work permits ,safety clearances etc. The students will also know about Indian electricity rules & Indian electricity acts .They will also know about electric shock and their prevention

2 . TEACHING AND EXAMINATION SCHEME

Semester	**V**								
Course code & course title		**Periods/Week (in hours)**			**Total Hours**	**Examination Scheme**			
						Theory Marks		**Practical Marks**		**Total Marks**
(EL632) Electrical Safety Management		L	T	P	H	TH	TM	TW	PR/OR	
		3	-	2	5	75	25	25	25	150

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

EL632.CO1: Explain the objectives and principles of electrical safety, effects of shocks, their prevention and first aid.

EL632.CO2: Demonstrate safety aspects with reference to different electrical safety hazards. .

EL632.CO3: Apply principles of electrical safety management to mitigate the risks.

EL632.CO4: Select suitable investigative techniques for determining the cause of electrical accidents, fires and explosion.

4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation & Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
EL632.CO1	1	1	2	-	3	3	3
EL632.CO2	1	3	2	3	3	3	3
EL632.CO3	1	2	2	-	1	1	-
EL632.CO4	3	3	2	3	3	3	3

Relationship : Low-1 Medium-2 High-3

	PSO1	PSO2
EL632.CO1	2	1
EL632.CO2	3	2
EL632.CO3	2	2
EL632.CO4	3	3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks | **Thr = Teaching hours** | **CO = Course Objectives**			
Unit	**M**	**Thr**	**CO**
1 INTRODUCTION TO ELECTRICAL SAFETY, ELECTRICAL SHOCKS AND THEIR PREVENTION	**18**	**12**	**CO1,CO2 ,CO4**
1.1 Introduction Objective of safety and security measures. Terms and definitions-danger, hazard, safety, safety devices, caution. Hazards associated with electric current and voltage, Principles of electrical safety, Approaches to prevent accidents.			
1.2 Electrical shocks and their preventions Occurrence of electric shocks and their classification, comparison between AC and DC shocks, Factors deciding the severity of electric shocks, Medical analysis of electric shocks and its effects. Lightening strokes on overhead transmission lines and outdoor substation Prevention of shocks, Safety precautions against contact shocks, flash shocks and burns. Safety precaution in small LV installations, residential buildings, shops. Safety procedure in electrical plants. Sequence of operation for circuit breaker isolators and earthing switch.			
1.3 Fires in electrical Installations Causes of fires in electrical installations, fire prevention, principle of extinguishing fire, List of fire extinguishers for fire-fighting, dos and don'ts in case of fire outbreak.			
2 FIRST AID	**12**	**8**	**CO1**
2.1 Removal of contact with live conductor, First principles of actions after electric shocks, Chocking, Poisoning, and Open wound, Control of bleeding, Burns and scalds, Accident management.			
2.2 Artificial respiration, Schafers prone pressure method, Silvester's method, Nielson's arm –lift back pressure method, Mouth to mouth method, Use of artificial resuscitator, External cardiac massage.			

3 EARTHING AND SAFETY IN ELECTRICAL PLANT	**15**	**10**	**CO1,CO2 ,CO3**
3.1 Terms related to earthing, Distinction between system earthing and equipment earthing, earthing systems in electrical substations or electrical plants (fence earthing, earthing mesh, structure/foundation earthing), requirements of earthing system, concept of step potential and touch potential. Definitions of clearance, creepage distance, clearance to earth, clearance between phases, clearances between phase to earth, clearance between phase to phase.			
3.2 Significance and practices followed for safety clearance (section clearance), ground clearance & creepage distances (leakage distances).			
4 SAFETY DOCUMENTATION AND WORK PERMIT SYSTEM	**12**	**8**	**CO2,CO3**
4.1 Significance of safety documentation and work permit system, List of safety documents in electrical work, Responsibilities of parties in electrical and fire Safety, Limited work permit (LWP), Permission to test, Safety key procedure, Safety tag system, Control of work permit.			
4.2 Safety aspects while putting an equipment/installations back in service, Safety aspects during re-commissioning after major maintenance/ repair work.			
5 SAFETY IN ELECTRICAL INSTALLATIONS AND IE RULES	**18**	**10**	**CO1,CO2 ,CO3,CO 4**
5.1 Objectives and scope of IE act and IE rules Electrical safety –general requirements as per IE rules i) Rule 32 Identification of earth and earthed neutral conductors ii) Rule 36 Handling of electric supply line apparatus iii) Rule 77 Clearance above ground of the lowest conductor iv) Rule 79 Clearance from buildings of low and medium voltage lines v) Rule 80 Clearance from building of high and extra high voltage lines			
5.2 Wiring and fitting, do's and don'ts for safety while using domestic electrical appliances Principles of safety management, Safety organization.			
5.3 Hazardous zones class 0, 1 and 2, Sparking, flashovers and corona discharge associated with electrical equipment and plant.			
Total	**75**	**48**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	Number of lectures	Marks
1	INTRODUCTION TO ELECTRICAL SAFETY, ELECTRICAL SHOCKS AND THEIR PREVENTION	12	18
2	FIRST AID	8	12
3	EARTHING AND SAFETY IN ELECTRICAL PLANT	10	15
4	SAFETY DOCUMENTATION AND WORK PERMIT SYSTEM	08	12
5	SAFETY IN ELECTRICAL INSTALLATIONS AND IE RULES	10	18
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK

No	**Practical** (Minimum 8)	Marks
1.	Visit to 11KV LT distribution system to identify risks & safety measures and prepare a report on same.	
2.	Visit to industrial establishment to study risks and safety practices followed and prepare a report on same.	
3.	Study of types of fire and fire extinguishing techniques and types of fire extinguishers for electrical fires.	
4.	Demonstrate the use of personal protective equipments	
5.	Case study 1: Electric shock due to water tap, wet wall etc	
6.	Case Study 2: Electric shock from household appliances.	
7	Case Study 3: Electrical safety in Hazardous Locations	
8.	Measurement of earth resistance and calculation of step potential and touch potential for an electrical installation.	
9.	Demonstration of various first aid techniques.	
10.	Conducting safety audit of an installation.	
	Total	25

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	S.Rao & S.L.Saluja	Electrical Safety, Fire safety Engineering and safety Management	Khanna Publication

Indian and International codes needed

S. No.	Author	Title of Books	Publishers
1	Government of IndiaMinistry of power central electricity board	THE INDIAN ELECTRICITY RULES, 1956	

Internet and Web Resources

S. No.	Author	Title of Books	Publishers
1	National Safety council, India	http://www.nsc.org.in/	National Safety council, India
2	Electricity department, Govt of Goa	Electrical Accident – Safety Aspect https://www.goaelectricity.gov.in/Regulations/Safety%20Aspect.pdf	Electricity department, Govt of Goa

(EL633) SMART GRID TECHNOLOGY

1. COURSE OBJECTIVES:

This course will present the concept of Smart grids from the multidisciplinary perspectives. It will provide technology aspects of smart grids including smart metering infrastructure, demand side management, electric vehicles, power quality management and information technology.

2. TEACHING AND EXAMINATION SCHEME

Semester	**VI**								
Course code & course title		**Periods/Week (in hours)**			**Total Hours**	**Examination Scheme**			
						Theory Marks		**Practical Marks**		**Total Marks**
(EL633) Smart Grid Technology		**L**	**T**	**P**	**H**	**TH**	**TM**	**TW**	**PR/OR**	
		3	-	2	5	75	25	25	25	**150**

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

EL633.CO1:Explain concepts and significance of smart grids .

EL633.CO2:Illustrate various instruments and systems used in smart grids.

EL633.CO3:Analyze implementation of different systems and power quality issues in Smart Grid

EL633.CO4:Assess different types of networks used for smart grids.

4. MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation & Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
EL633.CO1	2	1	1	1	2	1	2
EL633.CO2	2	2	1	3	2	2	3
EL633.CO3	3	3	3	3	3	2	3
EL633.CO4	2	2	1	2	2	2	3

Relationship : Low-1 Medium-2 High-3

	PSO1	PSO2
EL633.CO1	3	3
EL633.CO2	3	3
EL633.CO3	3	3
EL633.CO4	3	3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks | **Thr = Teaching hours** | **CO = Course Objectives**			
Unit	**M**	**Thr**	**CO**
1 Introduction To Smart Grid	9	6	CO 1
1.1 Evolution of Electric grid Definition, need and benefits of smart grid			
1.2 Opportunities and challenges in smart grid Difference between conventional grid and smart grid Concept of Resilient & self-healing Grid			
2 Smart Grid systems	18	14	CO 1, CO2, CO3
2.1 Demand response, architecture for DR implementation Smart Substations, Substation Automation			
2.2 Transmission systems: EMS, HVDC, Wide area monitoring, protection and control Distribution systems: DMS, Volt/VAr control, fault detection, isolation and service restoration, outage management			
2.3 Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid.			
3 Smart Meters And Advanced Metering Infrastructure	18	10	CO3
3.1 Introduction to Smart meters, Advanced Metering Infrastructure (AMI) drivers and benefits, AMI protocols, AMI needs in the smart grid.			
3.2 Automatic Meter Reading (AMR), Outage Management System (OMS), Smart Sensors, Home & Building Automation,			
3.3 Phase Measurement Unit (PMU). Intelligent Electronic Devices (IED) & their application for monitoring & protection			
4 Power Quality Management In Smart Grid	15	9	CO 3
4.1 Power Quality & EMC in Smart Grid			
4.2 Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid			
4.3 Web based Power Quality monitoring.			
5 Information Technology For Smart Grid	15	9	CO 4
5.1 Local Area Network (LAN), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN).			
5.2 Broadband over Power line (BPL), IP based Protocols, Basics of Web			

Service and CLOUD Computing to make Smart Grids smarter, Cyber Security for Smart Grid.			
Total	**75**	**48**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	**Unit**	**Number of lectures**	**Marks**
1	INTRODUCTION TO SMART GRID	6	9
2	SMART GRID SYSTEMS	14	18
3	SMART METERS AND ADVANCED METERING INFRASTRUCTURE	10	18
4	POWER QUALITY MANAGEMENT IN SMART GRID	9	15
5	INFORMATION TECHNOLOGY FOR SMART GRID	9	15
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	**Practical (Minimum 8)**	**Marks**
1.	Simulation & analysis of Grid connected micro grids.	
2.	Simulation & analysis of isolated micro grids.	
3.	Case study on DSM/ Demand response	
4.	Study & analysis of Smart grid technologies	
5.	Study of Communication techniques for smart grids	
6.	Simulation & analysis of different storage systems in micro grid	
7.	Study & analysis of power quality issues in Smart grid	
8.	Field visit to the site of the smart grids	
9.	Study of IEEE standards for implementation of smart grids	
10.	Case study of smart grids	
	Total	25

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	Janaka Ekanayake, Nick Jenkins	Smart Grid: Technology and Application	Wiley press
2	Clark W. Gellings	The Smart Grid: Enabling Energy Efficiency and Demand Response	CRC Press
3	James Momoh	Smart Grid : Fundamentals of Design and Analysis	Wiley IEEE press
4	James Claude Sabonnadière, Nouredine Hadjsaid	Smart Grids	Wiley Blackwell

SEMESTER VI

(EL601) ELECTRICAL DRIVES

1. COURSE OBJECTIVES

This course enables to develop the basics of electric drives and study different types of braking and speed control methods. The competency in this area is highly required in most of the industries since industries employ large number of motors and drives and their smooth operation and maintenance requires lot of competent man power.

2. TEACHING AND EXAMINATION SCHEME

Semester	**VI**									
Course code & course title		**Periods/Week (in hours)**			**Total Hours**	**Examination Scheme**				
						Theory Marks		**Practical Marks**		**Total Marks**
(EL601) Electrical Drives		L	T	P	H	TH	TM	TW	PR/OR	
		3	-	2	5	75	25	25	-	125

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

EL601.CO1: Explain concept and applications of electric drives
EL601.CO2: Demonstrate various methods of speed control and braking
EL601.CO3: Choose appropriate motors for given drive application
EL601.CO4: Design of simple control & power circuits for motors

4. MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation & Testing	Engg. Practices for Society, Sustainability &	Project Management	Life -long Learning
EL601.CO1	2	1	1	-	-	3	2
EL601.CO2	2	3	1	3	2	3	2
EL601.CO3	2	3	1	3	2	3	2
EL601.CO4	2	3	3	3	3	3	3

Relationship : Low-1 Medium-2 High-3

	PSO1	PSO2
EL601.CO1	1	-
EL601.CO2	2	2
EL601.CO3	2	2
EL601.CO4	2	2

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks | **Thr = Teaching hours** | **CO = Course Objectives**			
Unit	**M**	**Thr**	**CO**
1 DYNAMICS OF ELECTRIC DRIVE	18	08	CO 1
1.1 Concept and block diagram of electrical drive Merits & demerits of individual drive, group drive & multi motor drive, Factors governing selection of drive motor. Active and passive loads, types of loads based on variation of torque with respect to speed, Four quadrant operation of a motor driving a hoist load (including characteristics)			
1.2 Definition of stability, steady state stability, transient stability of drive system, stable and unstable operation of the drive with characteristics of motor and load Determination of referred load torque & referred moment of inertia to motor shaft (no numerical). Joint speed torque characteristics of electric motor & driven unit.			
2 BRAKING AND SPEED CONTROL	21	17	CO 1, CO2

2.1 Definition & its purpose: Advantages & Disadvantages of electrical braking. Concept of Dynamic, regenerative & counter current braking: Connection diagram and characteristics of DC shunt motors for Dynamic & counter current braking Connection diagram and characteristics of Dynamic (DC and AC) & counter current braking for Three phase squirrel cage Induction motors Characteristics of regenerative braking of Three phase Induction motors			
2.2 Speed control of 3 phase Induction motor: Pole changing method, voltage control, frequency control, voltage to frequency controls (v/f control), Rotor rheostat control, slip power recovery control (Kramer control method only)			
3 RATING & HEATING OF MOTORS	12	06	CO 3
3.1 Heating effect. Heating & cooling curves (no derivation),classes of duty, types of enclosures Determination of power rating of electric motor: continuous duty &			
variable load. Effect of load inertia, Load equalization (no numerical) Environmental factors affecting rating of motors.			
4 CONTROL & POWER CIRCUITS	18	11	CO1, CO 4
4.1 Symbol, working and applications of:- Push buttons (ON & OFF), overload relay, limit switches, float switches, time delay relay, selector switch, contactor			
4.2 Control circuits for- Interlocking control (push button and auxiliary contact), sequential controls (with and without TDR) Schematic control circuit & Power circuit diagram of 3 phase induction motor for — DOL starting, automatic star-delta starter, reversal of direction of rotation (direct & indirect reversal method), motor fed from two supply sources, remote control starting of an induction motor			
5 INDUSTRIAL APPLICATIONS OF ELECTRIC DRIVES	06	06	CO1, CO3
5.1 Study of drive motors for following applications : Lathes, refrigeration & air conditioning, pumps, lifts, cranes & machine tools.			
Total	**75**	48	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	Number of lectures	Marks
1	DYNAMICS OF ELECTRIC DRIVE	08	18
2	BRAKING AND SPEED CONTROL	17	21
3	RATING & HEATING OF MOTORS	06	12
4	CONTROL & POWER CIRCUITS	11	18
5	INDUSTRIAL APPLICATIONS OF ELECTRIC DRIVES	06	06
	Total	**48**	**75**

8. SPECIFICATION TABLE FOR TERM WORK

No	Practical (Minimum 8)	Marks
1.	Dynamic braking in D.C. shunt motor for different values of external resistance	
2.	Counter current braking/ plugging in D.C. shunt motor	
3.	Dynamic braking of 3phase induction motor using DC & single phase AC supply	
4.	Plugging in 3 phase induction motor	
5.	Speed control of 3 phase Induction motor by E.M.F. injection method (Schrage motor)	
6.	Speed control of 3 phase Induction motor by pole changing method.	
7.	Design, assemble & testing of control circuit for individual operation of motors	
8.	Design, assemble & testing of control circuit for sequential control operation of two or more motors with & without time delay.	
9.	Design, assemble & testing of control circuit for interlocking operation of two motors for direction reversal or taking supply from two sources	
10.	Design, assemble & testing of control circuit for remote control operation of a motor from 2-3 locations	
11.	Design, assemble & testing of control circuit for manual & automatic star-delta starter	
12.	To study the drive system & control circuit of lathe machines	
13.	To study drive system & control circuit of milling machine	
14.	To study drive system & control circuit of radial drilling machine	
	Total	25

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	S. K. Pillai	A first course on electrical drives	New Age
2	Dubey	Fundamentals of Electric Drive	Tata Mcgraw
3	V. Subramaniam	Electric Drives	Tata Mcgraw
4	S.K. Bhattacharya	Industrial Electronics & Control	Technical Education Series
5	U. S. Eshwar	Handbook of Electric Motor Control	McGraw-Hill

(EL 602) PROJECT

1. COURSE OBJECTIVES:

This is intended to integrate several skills and competencies which have been developed in the students during his/her course of study and gets manifested through this project.

2. TEACHING AND EXAMINATION SCHEME

Semester	**VI**								
Course code & course title		**Periods/Week (in hours)**			**Total Hours**	**Examination Scheme**			
						Theory Marks		**Practical Marks**	**Total Marks**
(EL 602) PROJECT		**L**	**T**	**P**	**H**	**TH**	**TM**	**TW**	**PR/OR**	
		-	**-**	**06**	**06**	**-**	**-**	**100**	**50**	**150**

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

EL602.CO1: Identify and define the problem taken up as project topic
EL602.CO2: Apply the acquired knowledge and skills of engineering to plan and organize solution for the problem
EL602.CO3: Collect, analyze and test data relevant to problem
EL602.CO4: Develop leadership, soft skills & teamwork to design , execute hardware/software and compile findings in form of report

4. MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation& Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
EL602.CO1	3	3	2	1	2	3	3
EL602.CO2	3	3	3	2	3	3	3
EL602.CO3	3	3	3	3	3	3	3
EL602.CO4	3	3	3	3	3	3	3

Relationship : Low-1 Medium-2 High-3

	PSO1	PSO2
EL602.CO1	3	1
EL602.CO2	3	2
EL602.CO3	3	2
EL602.CO4	3	2

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

The following are some of the suggested activities which the student has to undertake (which may slightly differ depending on the project chosen) during the project work. In so doing some process related and project related skills need to be evaluated.

- Selection/Identification of project Work by market survey/industrial survey.
- Project Proposal
- Market survey for product sales & economic viability of product (for entrepreneurship)
- Costing of the project/product i) Capital costs ii) Material & production cost
- Design of project to obtain desired output.
- Procurement of components & equivalents.
- Working skill of fabrication.
- Testing of product
    i. Drafting
    ii. Sketching
    iii. Layout
    iv. Presentation
- Project Report

(CC502) ESSENTIALS OF ENTREPRENEURSHIP DEVELOPMENT

1. COURSE OBJECTIVES

Today Entrepreneurship is given importance by the government to bring the youth of our country to overcome the problem of unemployment and bring them in the main stream of global business to strengthen Indian economy by Make in India philosophy. Government has announced various financial schemes for young youth and women to support them for setting up an enterprise. To fulfill this, youth are to be prepared for setting an enterprise. The students undergoing this course will be develop entrepreneurial traits and confidence within themselves and choose entrepreneurship as a career to brighten their future.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/ Week (In Hours)			Total Hours	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
CC502 Essentials of Entrepreneurship Development	**L**	**T**	**P**	**H**	**-**	**-**	**PR/OR**	**TW**	25
	-	-	2	2	-	-	-	25	

Minimum passing % Practical 40%

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

CC502.CO1: Recognize the type of entrepreneur and enterprises.
CC502.CO2: Summarize basic financial terms and market research.
CC502.CO3: Identify legal formalities required for Business.
CC502.CO4: Develop the project report for new enterprise.

4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation & Testing	Engg. Practices for Society, Sustainability& Environment	Project Management	Life -long Learning
CC502.CO1	1	0	0	0	2	3	2
CC502.CO2	2	0	0	0	0	3	2
CC502.CO3	0	1	2	0	0	0	2
CC502.CO4	3	2	2	0	2	0	2

Relationship :Low-1 Medium-2 High-3

5. MAPPING COURSE OUTCOMES WITH PROGRAM SPECIFIC OUTCOMES

	PSO1	PSO2
CC502.CO1	2	2
CC502.CO2	1	1
CC502.CO3	2	2
CC502.CO4	2	2

6. DETAILED COURSE CONTENTS

M=Marks	Phr= Practical hours	CO – Course Outcomes			
Unit			M	Phr	CO
1.INDIAN BUSINESS ENVIRONMENT					
a. Introduction to Entrepreneurship Development (EDP) b. Brief details of following terms: India GDP, IIP data, Govt. business policies, Environmental policy, Effects of global policies, Anti-dumping duty, Effects of national budget onstart-ups and businesses.				4	CO1
2. VARIOUS TYPES OF BUSINESSES					
2.1 Brief details of following businesses: Cyclical andNon-cyclical business, Seasonal and Non-seasonal business, Monopoly and Duopoly business, Concept base business, Commodity andNon-commodity business, Asset light business, b2b and b2c business, 2.2 Difference between Subsidiary and Associate company				6	CO1
3. SELECTION OF BUSINESS					
3.1 Types ofSectors, Steps in sectoral analysis, factors to pick up a Sector, Data collection of Sectors. 3.2 Terminologies:Sector rotation, Gross block addition. 3.3 Steps to read Outline of balance sheet, profit-loss statement, cash flow statement. 3.4 Data analysis on following factors: i)Market growth ii)Sector consolidation. 3.5 Brief details of following: Profitability, Effect of Govt policies, Pricing power, Debt, working capital, return on capital employed, Cash conversion cycle, Companies with peer group.				4	CO1 CO2
4 SETTING UP OF BUSINESS					
4.1 Various Govt depts. and organization supporting business ideas. 4.2 Methods to raise capital (difference between Banks and NBFC). 4.3Factors in machine, material, manpower procurement, advertising, product specialty, 4.4 Micro, Small and Medium Enterprises (MSME), Govt support for MSME, Private Limited and Public Limited Enterprises, 4.5 Goods &Service Tax(GST), Registering for GST and go ahead, 4.6Various income tax slabs, 4.7Application for various utility connections, various permissions required to set up business.				10	CO1 CO2 CO3

5. EXPANSION OF BUSINESS			
5.1Types of investors: angel investors, venture capitalist, promoters. 5.2Terminology: 5.2.1 EPS, EPS growth, P/E ratio, 5.2.2 Market capital, paid up capital, authorized share capital, 5.2.3Corporate governance, Related party transactions, business insiders, assets and inventory turnover, break even analysis, brown field and green field expansion. 5.3Listing start up on stock exchange&Govt support. 5.4Business report writing, Reading of Red Herring prospectus		8	CO1 CO2 CO3 CO4
Total	25	32	

7. COURSE DELIVERY:

Videos / Lectures/ Practicals /Expert lectures / Industry visits/ documentaries/movies

Suggested expert talk on

- various Govt schemes
- GST
- Financial literacy
- Any relevant topic

8. SPECIFICATION TABLE FOR PRACTICALS

Unit No.	Topic	Teaching Hours/ Semester
1	**Indian business environment**	**4**
2	**various types of businesses**	**6**
3	**selection of business**	**9**
4	**Setting up of business**	**9**
5	**Expansion of business**	**4**
TOTAL		**32**

9. SPECIFICATION TABLE FOR TERM WORK & PRACTICAL HOURS

No	**Classroom Assignments**	**Marks**
1.	Prepare a Case Study on leading enterprise or small-scale unit	**6**
2.	Prepare a report on various government schemes for startup.	**4**
3.	Prepare SWOT analysis for a new business idea.	**5**
4.	Prepare Project Report for a new business idea.	**10**
	OR	
1.	Preparing a project report on basis of draft Red Herring prospectus	**25**

10. LEARNING RESOURCES

S.No.	Author	Title of Books	Publisher
1.	Sharadjawadekar, shobhadodlani,	Business entrepreneurship	Suvicharprakashanmandalpune,
2.	S.S. Khanna	Entrepreneurship development	S. Chand & Co. Ltd, New Delhi,
3.	Vasant Desai	Management of small-Scale Industry in India	Himalaya Publishing House
4.	DilipSarwate	Entrepreneurial development Concepts and practices	Everest Publication House, Pune
5.	CB Gupta and P Srinivasan	Entrepreneurship Development	S. Chand and Sons, New Delhi

https://ncert.nic.in/ncerts/l/leac203.pdf

https://ncert.nic.in/ncerts/l/leac204.pdf

https://www.wirc-icai.org/images/publication/IND-AS-BOOK.pdf

https://cma.org.sa/en/Awareness/Publications/booklets/Booklet_4.pdf

https://www.icsi.edu/media/portals/25/IPO.pdf

https://old.mu.ac.in/wp-content/uploads/2017/01/FINANCIAL-STATEMENT-ANALYSIS.pdf

https://ncert.nic.in/textbook/pdf/jess202.pdf

https://dea.gov.in/sites/default/files/

https://dea.gov.in/monthly-economic-report-table

https://rbidocs.rbi.org.in/rdocs/Publications/PDFs/0HSIE_F.PDF

https://ncert.nic.in/textbook/pdf/lebs202.pdf

https://www.oecd.org/industry/inv/investmentfordevelopment/33806126.pdf

https://www.youtube.com/watch?v=NV8Ew6PcQhY

file:///C:/Users/User/Downloads/1-s2.0-S0970389617304664-main.pdf

(CC601) INDUSTRIAL ORGANISATION AND MANAGEMENT

1. COURSE OBJECTIVES

Management is the basic need of any organization. Organization consists of multiple activities which are to be systematically managed for effective output. The course covers various principles related to organization and management. The areas covered are finance, human resource, project management etc. After completion of the course, the student will be acquainted with management and other related aspects so that he/she will be able to apply this knowledge in order to achieve the organizational goals.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/ Week (in hours)			Total Hours	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
CC601 Industrial Organisation and Management	L	T	P	H	TH	TM	TW	PR/OR	100
	3	-	-	3	75	25	-	-	

3. COURSE OUTCOMES

On successful completion of the course, the student will be able to:

CC601.CO1: Describe types of business organizations.

CC601.CO2: Apply the principles of managing Men, Machines, and Materials in an industry.

CC601.CO3: Evaluate financial status of an industrial organization.

CC601.CO4: Develop problem solving skills in project management

4. MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific	Problem Analysis	Design and Devlopment of Solutions	Engg. Tools, Experimentation& Testing	Engg. Practices for Society,Sustainability& Environment	Project Management	Life -long Learning
CC601.CO1	2	0	0	0	0	1	0
CC601.CO2	2	1	1	1	1	2	2
CC601.CO3	3	2	1	2	3	3	2
CC601.CO4	3	3	2	2	2	3	3

Relationship : Low-1 Medium-2 High-3

	PSO1	PSO2
CC601.CO1	2	2
CC601.CO2	2	2
CC601.CO3	1	1
CC601.CO4	3	2

5. DETAILED COURSE CONTENTS/ MICRO-LESSON PLAN

M=Marks | **Thr= Teaching hours** | **CO= Course Outcomes**			
Unit	**M**	**Thr**	**CO**
1.BUSINESS ORGANIZATION **1.1** Types of business organizations: Individual proprietorship, Partnership, Joint Stock Companies: Private Ltd and Public Ltd, Co-operative societies, Public sector **1.2** Structure of business organization: Line organization, Functional Organisation,Line and staff organization, Project organization	10	6	CO1CO2
2.BUSINESS MANAGEMENT **2.1:** Concept of management and administration, management as an art and science, evolution and growth of scientific management- contribution of F.W Taylor. **2.2** Basic functions of management: planning, organizing, staffing, directing, controlling. Other functions: forecasting, coordinating and decision- making. **2.3** Functions in Industry: Basics of Procuring, store- keeping, material handling, production, packing and forwarding, marketing and sales, supervision, research and development. **2.4** Supervisory skills required in industry	16	9	CO1CO2 CO3
3.BASICS OF FINANCE **3.1** Sources of finance **3.2** Cost Concepts: Necessity of costing, elements of cost: material, Labour and expense; prime cost, overhead cost, total cost, And break- even analysis. **3.3** Materials management: Inventory control-standard order, reserve stock, reorder point, lead time. Economic order quantity, ABC Analysis. Introduction to Just in time (JIT) system **3.4** Depreciation: Definition and causes. Methods of calculating depreciation charges: Straight Line Method, Diminishing Balance Method, Sinking Fund method .(Simple Numericals) **3.5** Obsolescence- definitions and reasons. **3.6** Introduction to GST.	18	13	CO1CO2 CO3CO4
4.HUMAN RESOURCE MANAGEMENT **4.1** Functions of Personnel Department**:** Human resource planning, selection and recruitment, training, promotion and transfer, welfare of employees. **4.2** Industrial Relations**:** Employer-employee relations, trade union, settlement of disputes of employees, collective bargaining,	21	14	CO1CO2 CO3CO4

conciliation, arbitration, grievance handling mechanism. **4.3** Wages and Incentives**:** Factors influencing wages, types of wage plans – time rate and piece rate, Incentive – objectives and types, individual and group incentive plan, characteristics of a good wage or incentive plan, difference between incentive and wage. **4.4** Industrial Acts: Introduction to the following Industrial Acts: Industrial Disputes Act 1947/1956; The Indian Factories Act 1948 The Workmen's Compensation Act 1923			
5.PROJECT MANAGEMENT **5.1** Introduction to Project Management **5.2** Network Analysis (Introduction to basic concepts with simple Numericals) CPM- Critical Path Method: Definition, network diagrams, critical path, advantages PERT- Programme Evaluation and Review Technique: Definition, network diagrams, advantages. Comparison of PERT and CPM.	10	6	CO1CO2 CO3CO4
Total	**75**	**48**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	Number of lectures	Marks
1	**Business Organization**	**6**	**10**
2	**Business Management**	**9**	**16**
3	**Basics of Finance**	**13**	**18**
4	**Human Resource Management**	**14**	**21**
5	**Project Management**	**6**	**10**
	Total	**48**	**75**

8. LEARNING RESOURCES

Text Books

S.No	Author	Title of Book	Publisher
1	O.P. Khanna	Industrial Engineering and Management	DhanpatRai Publications
2	T.R.Banga ,S.C. Sharma	Industrial Organisation and Engineering Economics	Khanna Publishers
3	Awate,Chunawala, Patel,Bhandarkar, Sriniwasan	Industrial Organisation and Management	Vrinda Publication
4	MartandTelsang	Industrial Engineering and Production Management	S.Chand& Company Ltd

AUDIT COURSE

(AC102) INDIAN CONSTITUTION

1. COURSE OBJECTIVES:

As a proud citizen of this country every student must be aware about the Indian Constitution to appreciate the provisions available for the people of this biggest democracy in Indian Constitution so that the youth of this country plays active role in development of the country by participating in the formation of sensitive and proactive Government at national and state level.This course intends to make students aware about various constituents of the Indian Constitution.

2. TEACHING AND EXAMINATION SCHEME

Semester	VI									
Course code & course title		Periods/Week (in hours)			Total Hours	Examination Scheme				
						Theory Marks		Practical Marks		Total Marks
(AC102) INDIAN CONSTITUTION		L	T	P	H	TH	TM	TW	PR/OR	
		2	-	-	2	-	-	-	-	-

3. Course Content

Unit 1 – The Constitution – Introduction • The History of the Making of the Indian Constitution • Preamble and the Basic Structure, and its interpretation • Fundamental Rights and Duties and their interpretation • State Policy Principles
Unit 2 – Union Government • Structure of the Indian Union • President – Role and Power • Prime Minister and Council of Ministers • Lok Sabha and Rajya Sabha
Unit 3 – State Government • Governor – Role and Power • Chief Minister and Council of Ministers • State Secretariat
Unit 4 – Local Administration • District Administration • Municipal Corporation • Zila Panchayat
Unit 5 – Election Commission • Role and Functioning • Chief Election Commissioner • State Election Commission

4. Suggested Learning Resources:

Title of Book Author Publication
1. Ethics and Politics of the Indian Constitution Rajeev Bhargava Oxford University Press, New Delhi,2008
2. The Constitution of India B.L. Fadia Sahitya Bhawan; New edition (2017)
3. Introduction to the Constitution of India DD Basu Lexis Nexis; Twenty-Third 2018 edition

5. Suggested Software/Learning Websites:

a. https://www.constitution.org/cons/india/const.html
b. http://www.legislative.gov.in/constitution-of-india
c. https://www.sci.gov.in/constitution
d. https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-ofindia/

ELECTIVE II

(EL618) TESTING & MAINTENANCE OF ELECTRICAL MACHINES

1. COURSE OBJECTIVES

This subject enables the student to understand the various types of tests and maintenance practices to be carried out on DC & AC electrical machines such as transformer, induction motor, synchronous machines. The students would get acquainted with the knowledge and exact procedure of carrying out these tests and also get familiarized with the various types of storage practices.

2. TEACHING AND EXAMINATION SCHEME

Semester	**VI**								
Course code & course title		**Periods/Week (in hours)**			**Total Hours**	**Examination Scheme**			
						Theory Marks		**Practical Marks**		**Total Marks**
(EL618) Testing & Maintenance of Electrical Machines		L	T	P	H	TH	TM	TW	PR/OR	
		3	-	2	5	75	25	25	25	150

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

EL618.CO1: Classify the various types of tests conducted on electrical machines.

EL618.CO2: Demonstrate the different types of tests on electrical machines.

EL618.CO3: Analyze the performance of various electrical machines.

EL618.CO4: Discuss the maintenance schedule for various electrical machines.

4. MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation& Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
EL618.CO1	2	-	-	-	-	-	2
EL618.CO2	2	1	2	3	-	3	2
EL618.CO3	3	3	1	3	2	3	3
EL618.CO4	2	3	2	-	-	3	2

Relationship : Low-1 Medium-2 High-3

	PSO1	PSO2
EL618.CO1	1	1
EL618.CO2	2	2
EL618.CO3	3	1
EL618.CO4	2	1

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	**Thr = Teaching hours**	**CO = Course Objectives**			
Unit			**M**	**Thr**	**CO**
1.INTRODUCTION			**6**	**4**	CO1, CO2
1.1 Classification of tests: type test, routine test, acceptance test, pre-commissioning/commissioning test. Methods of measurement of temp rise of various parts of machines, Concept of direct, indirect and regenerative testing (phantom loading) their advantages and disadvantages.					
2. DC MACHINE TESTING			**12**	**8**	CO1, CO2, CO3
2.1 Classification of various losses in DC machines as per IS and the separation of various losses Definition of mechanical, electrical and overall efficiency. Methods of determining efficiency by brake test, Swinburne test and Hopkinson test. (No derivation, only numericals)					
3 .TRANSFORMER TESTING			**18**	**12**	CO2
3.1 Tests and their importance on transformer - Phasing out test, ratio and polarity test. Measurement of winding resistances, insulation resistance test, O.C. and S.C. test for calculation of efficiency and voltage regulation.					
3.2 Methods of measurement of temperature rise and permissible temperature rise as per IS. Temperature rise tests:- a) Direct load test, b) Back to back test/ Sumpner's test. High voltage and impulse voltage withstand test, acceptance test.					
4 INDUCTION MOTOR TESTING			**24**	**14**	CO1, CO2, CO3, CO4

4.1 Various types of losses in motor, calculation of rotor input power, rotor output power, mechanical power developed and motor output.				
4.2 Classification of tests:- Type test, routine test and special test as per IS . Load test, measurement of temperature of various parts of				
induction motor (temperature rise test), insulation resistance test and high voltage test, acceptance test				
4.3 Synchronous Machines (No Numericals): Classification of losses, and steps for computation of efficiency from losses as per IS				
5 TESTING AND MAINTENANCE SCHEDULE	**15**	**10**	CO2, CO3	
5.1 Testing and maintenance schedule for transformer and induction machine as per I.S. Care of electrical equipment during period of inactivity and storage. Pre-commissioning testing and maintenance, installation. Maintenance schedule for transformer and induction machine as per IS.				
5.2 Re-varnishing process of winding of electrical equipment - Vaccum impregnation, dip impregnation and coating.				
5.3 Causes of failure, its frequency of occurrence and trouble shooting in transformers. Causes of failure, its frequency of occurrence and trouble shooting in induction machines. Total	**75**	**48**		

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	**Unit**	**Number of lectures**	**Marks**
1	INTRODUCTION	4	6
2	DC MACHINE TESTING	8	12
3	TRANSFORMER TESTING	12	18
4	INDUCTION MOTOR TESTING	14	24
5	TESTING AND MAINTENANCE SCHEDULE	10	15
	Total	**48**	**75**

8. SPECIFICATION TABLE FOR TERM WORK

No	Practical (Minimum eight)	Marks
1.	To perform brake test on D.C. shunt motor & calculation of its efficiency.	
2.	To perform Swinburn's test on D.C. shunt motor, determination of the various losses and its efficiency as motor and generator.	
3.	To perform Hopkinson's test on D.C machines and calculation of its efficiency.	
4.	To perform back to back test on a transformer, to determine the losses and calculation of efficiency as well as regulation.	
5.	To perform vector group test on three phase transformer.	
6.	To perform reduced voltage running up test on a three phase induction motor at various loads such as (1) No load ,(2) ¼ of full load ,(3) ½ full load.	
7.	To perform continuity test and insulation resistance test on windings of three phase induction motor.	
8.	To perform temperature rise test in a three phase induction motor.	
9.	To perform direct load test to determine efficiency of an alternator.	
10	To perform temperature rise test in transformer .	
11	Field Visit.	
	Total	25

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	S. Rao	Testing, Commissioning, operation and maintenance of electrical equipment	Khanna Publishers
2	S. K. Bhattacharjee	Electrical Machines	Tata Mc graw
3	B. V. S Rao	Operation & Maintenance of Electrical Equipment	Khanna Publisher

(EL630) ENERGY MANAGEMENT

1. COURSE OBJECTIVES

Course content will create awareness on energy management, energy audit, energy conservation & opportunities for energy conservation through energy management. Students will understand and implement methodologies of energy performance assessment of electrical utilities and propose improvements.

2. TEACHING AND EXAMINATION SCHEME

Semester V									
Course code & course title	**Periods/Week (in hours)**			**Total Hours**	**Examination Scheme**				
					Theory Marks		**Practical Marks**		**Total Marks**
(EL630) Energy Management	**L**	**T**	**P**	**H**	**TH**	**TM**	**TW**	**PR/OR**	
	3	-	2	5	75	25	25	25	**150**

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

EL630.CO1: Explain the terms related to energy management and their significance
EL630.CO2: Apply the knowledge of energy management, audit, conservation and related opportunities & procedure for energy management in day to day operations
EL630.CO3: Analyze tariff systems, capacity for power factor improvement and energy performance of given electrical installation.
EL630.CO4: Choose appropriate energy efficient technology for given electrical system.

4. MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation & Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
EL630.CO1	3	1	1	1	3	2	2
EL630.CO2	3	3	2	3	3	3	3
EL630.CO3	3	3	3	1	3	3	3
EL630.CO4	3	2	2	2	3	3	3

Relationship : Low-1 Medium-2 High-3

	PSO1	PSO2
EL630.CO1	1	-
EL630.CO2	3	3
EL630.CO3	3	3
EL630.CO4	3	3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	**Thr = Teaching hours**	**CO = Course Objectives**			
Unit			**M**	**Thr**	**CO**
1. GENERAL ASPECTS OF ENERGY MANAGEMENT			12	10	CO1 CO2
1.1 Concept of energy management, necessity of energy management. Opportunities for energy management: Concept of supply side and load/demand side energy management. Load curve, importance of flattening load curve and methods to achieve flat load curve. Quality of incoming supply and its effect on the performance of machinery, equipments and lighting					
1.2 Energy security- options and opportunities. Energy conservation and its importance, energy strategy for future, main features of energy conservation act 2001.					
2. ENERGY AUDIT			09	04	CO1 CO2
2.1 Definition and need for energy audit Classification of energy audit: Preliminary and detailed audit. Ten steps methodology for detailed energy audit. Instruments used for energy audit					
3. **ELECTRIC LOAD MANAGEMENT, TARIFF AND POWER FACTOR IMPROVEMENT**			18	10	CO1 CO2 CO3
3.1 Objectives of tariff, components of tariff structure, types of tariff (block rate, maximum demand, power factor tariffs), estimation of bill for HT and LT installations.					
3.2 Power factor, advantages of power factor improvement, cost benefits of power factor improvement, calculation of capacitor KVAR for power factor improvement.					
3.3 Need for electric load management, step by step approach for maximum demand control, calculation of maximum demand.					
4. ENERGY PERFORMANCE ASSESSMENT OF ELECTRICAL UTILITIES			18	12	CO1 CO2 CO3 CO4
4.1 Lighting system:					

Performance terms and definitions: lumen, lux, circuit watts, installed load efficacy, installed load efficacy ratio, average maintained luminance, room index, color rendering index. Preparation before lighting performance assessment Procedure for lighting performance assessment (Numerical) Areas for improvement			
4.2 Motors: Performance terms and definitions : motor loading, motor efficiency Procedure for motor performance assessment (Numerical) Determination of motor loading by various methods			
4.3 pumps: Performance terms and definitions: pump capacity, total developed head, system resistance, hydraulic power, pump efficiency. Procedure for pump efficiency assessment (Numerical) Methods for Flow measurement			
5. **ENERGY EFFICIENT TECHNOLOGIES**	18	12	CO1 CO2 CO4
5.1 Concept of Maximum demand controllers, Automatic power factor controller Energy efficient motors, minimizing watt losses in motors, technical aspects of energy efficient motors, soft starter and its advantages, variable frequency drive concept. Improvement of efficiency of transformers (Energy efficient transformers)			
5.2 Energy efficient lighting controls (Brief description): occupancy sensors, time based control, daylight linked control, localized switching. Electronic ballast, comparison between conventional and electronic ballast.			
Total	**75**	**48**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	Number of lectures	Marks
1	GENERAL ASPECTS OF ENERGY MANAGEMENT	10	12
2	ENERGY AUDIT	04	09
3	ELECTRIC LOAD MANAGEMENT, TARIFF AND POWER FACTOR IMPROVEMENT	10	18
4	ENERGY PERFORMANCE ASSESSMENT OF ELECTRICAL UTILITIES	12	18
5	ENERGY EFFICIENT TECHNOLOGIES	12	18
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK(Minimum 8)

No	Practical	Marks
1.	Case study on energy consumption pattern from monthly electricity bills of LT installation	
2.	Case study on energy consumption pattern from monthly electricity bills of HT installation	
3.	Case study on load variation pattern and load curve analysis of given installation	
4.	Energy performance assessment of lighting system	
5.	Energy performance assessment of motor	
6.	Calculation of KVAR rating of capacitor for power factor improvement of a given installation	
7.	Design of solar photovoltaic system for given installation and calculation of payback period	
8.	Energy audit and energy conservation in small industry	
9.	Energy audit and energy conservation in small Institute	
10.	Energy audit and energy conservation in small Hospital	
	Total	25

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	V.K. Mehta	Principle of Power System	S. Chand
2		General Aspects of energy management and energy audit Guide book 1	Bureau of energy efficiency
3		Energy efficiency in electrical utilities Guide book 3	Bureau of energy efficiency
4		Energy performance assessment for equipment and utility systems Guide book 4	Bureau of energy efficiency

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(EL634) INSTRUMENTATION IN POWER PLANT

1. COURSE OBJECTIVES

1. To understand about various power generation methods.
2. To identify various parameters and measurement techniques for controlling in power plant.
3. To analyse different processes used in power generation.
4. To select suitable control techniques in control of furnace ,boiler and turbines

2. TEACHING AND EXAMINATION SCHEME:-

Semester	**VI**								
Course code & course title		**Periods/Week (in hours)**			**Total Hours**	**Examination Scheme**			
						Theory Marks		**Practical Marks**	**Total Marks**
(EL634)		**L**	**T**	**P**	**H**	**TH**	**TM**	**TW**	**PR/OR**
Power Plant Instrumentation		**3**	**-**	**2**	**5**	**75**	**25**	**25**	**25**	**150**

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

EL634.CO1: Describe various processes of thermal power plant
EL634.CO2: Draw P & I diagram for various processes of thermal power plant
EL634.CO3: Measure various control parameters of thermal power plant equipments
EL634.CO4: Examine boiler, furnace and turbine control techniques.

4. MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation & Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
EL634.CO1	3	1	1	1	1	-	1
EL634.CO2	2	2	1	1	1	-	1
EL634.CO3	2	2	2	3	3	1	3
EL634.CO4	3	3	2	3	2	2	3

Relationship : Low-1 Medium-2 High-3

	PSO1	PSO2
EL634.CO1	1	2
EL634.CO2	1	2
EL634.CO3	2	2
EL634.CO4	2	2

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	**Thr = Teaching hours**

Unit	**M**	**Thr**	**CO**
1POWER GENERATION METHODS	**15**	**10**	**CO1, CO2**
1.1 Review of methods of power generation: hydro, thermal, nuclear, solar and wind power , 1.2 importance of instrumentation in power generation , 1.3 thermal power plants: Components and block diagram, details of boiler processes, P& I diagram of boiler, 1.4 cogeneration.			
2 MEASUREMENTS IN POWER PLANTS	15	10	**CO3**
2.1 Electrical measurements: current, voltage, power, frequency, power factor , 2.2 non electrical parameters: flow of feed water, fuel, air, steam pressure and steam temperature , smoke density measurement , 2.3 Flue gas oxygen analyzer , pollution monitoring instruments			
3 FURNACE CONTROL	15	10	**CO3,CO4**
3.1 Coal handling: Pulverizers 3.2 Furnace Draught: natural draught, forced draught, induced draught, power requirements for draught systems , 3.3 Combustion control: Fuel/Air ratio, combustion efficiency, excess air, parallel and cross limiting combustion control, soot-blowing operation			
4 BOILER CONTROL	15	10	**CO3,CO4**
4.1 Boiler temperature measurement, pressure measuring devices, 4.2Boiler feed water processing and control ,drum level measurement methods, 4.3 steam temperature control: main steam and reheat steam temperature control, superheater control, deaerator control , 4.4 distributed control system in power plants ,			

interlocks in boiler operation			
5 TURBINE CONTROL	15	8	**CO3,CO4**
5.1 Speed measurement, rotor and casing movement-vibration , 5.2 shell temperature monitoring and control , steam pressure control , lubricant oil temperature , 5.3 cooling system			
Total	**75**	**48**	**-**

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No.	**Unit**	**Number of lectures**	**Marks**
1	POWER GENERATION METHODS	10	15
2	MEASUREMENTS IN POWER PLANTS	10	15
3	FURNACE CONTROL	10	15
4	BOILER CONTROL	10	15
5	TURBINE CONTROL	8	15
		48	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No.	Practical (any six)	Marks
1	Measurement of Electrical parameters relevant to Thermal power plant	
2	Measurement of steam flow, air flow and fuel flow and water flow in a thermal power plant	
3	Measurement of constituents of flue gas using suitable meters	
4	Drawing P&I diagram for Boiler	
5	Drawing P&I diagram and demonstration of Combustion control of Furnace	
6	Demonstration of controls for maintaining boiler drum water level	
7	Demonstration of control circuit for hydraulic systems of turbine	
8	Field visit to power plant/Video demonstration	
	Total	25

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1.	Krishnaswamy KM, Bala P, Bala MP	Power Plant Instrumentation	Prentice Hall
2.	Sam G. Dukelow	The control of Boilers	Instrument Society of America

Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	Elonka.S.M.andKohal A.L	Standard Boiler Operations	McGraw-Hill, New Delhi
2	Jain R.K	Mechanical and industrial Measurements	Khanna Publishers,

(EX635) BUILDING AUTOMATION

1. COURSE OBJECTIVES:

The students will be able to:

1. Understand the architecture of BMS, list the various components and describe their functions
2. Understand working of HVAC
3. Analyse control loops used in HVAC

2. TEACHING AND EXAMINATION SCHEME

Semester	VI								
Course code & course title		Periods/Week (in hours)			Total Hours	Examination Scheme			
						Theory Marks		Practical Marks		Total Marks
(EX635) Building Automation		L	T	P	H	TH	TM	TW	PR/OR	
		3	-	2	5	75	25	25	25	150

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

EX635.CO1: Select components of BMS, and assemble components to build BMS system

EX635.CO2: Measure and interpret trends of various parameters used in BMS

EX635.CO3: Identify and classify various components of HVAC based on functionality

EX635.CO4: Apply control techniques to HVAC systems

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4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Devlopment of Solutions	Engg. Tools, Experimentatn& Testing	Engg. Practices for Society,Sustainability& Environment	Project Management	Life -long Learning
EX635.CO1	3	3	3	-	-	-	2
EX635.CO2	2	-	-	3	-	-	2
EX635.CO3	2	-	3	-	-	-	-
EX635.CO4	2	2	1	3	2	-	-

Relationship : Low-1 Medium-2 High-3

	PSO1	PSO2
EX635.CO1	2	2
EX635.CO2	2	3
EX635.CO3	1	1
EX635.CO4	3	3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	**Thr = Teaching hours**	**CO = Course Objectives**			
Unit			**M**	**Thr**	**CO**
1 BMS Fundamentals			**15**	**10**	**CO1**
1.1 BMS Fundamentals Introduction to BMS, BCS And EMS, advantages of BMS , applications areas, components of BMS system					
1.2 System configuration , Hardware configuration : Several levels of processors in Microprocessors based hierarchical configuration					
1.3 System Function i] Zone Level Function ii] System Level Controller Functions iii] Operator Level Functions					
1.4 Communication Media: Typical Wiring Configuration : Series bus, Star wiring					
1.5 Communication trunks in BMS transmission i] Twisted Copper Pairs ii] Fiber Optical Cable iii] Common Carrier telephone channel					
1.6 Communication Protocol i] Peer Communication Protocol ii] Poll/Response Protocol iii] Backnet iv] Lonwork v]KNX vi] Modbus vii] Zigbee					
2 Comfort parameters measurement in BMS system			15	10	**CO2**
2.1 Temperature: Heat, Specific Heat, Sensible , Heat & Latent Heat, Enthalpy, Adiabatic process ,BTU, isothermal process Working Principle, Characteristics of different types of temperature sensors- RTD, Thermistor, Thermocouple					
2.2 Humidity: Moisture content , Relative Humidity, Dew point, Saturation point, dry bulb & Wet bulb temperature, Working principle of different types of relative humidity sensors- capacitive type. Psychrometric chart-Introduction to different axis in					

Psychrometric chart			
2.3 Pressure: Static Pressure, Absolute Pressure, Gauge Pressure,Vacuum, Pressure, Differential Pressure, Working Principal of Different types of Pressure Sensors- Diaphragm type, Piezoelectric sensors			
2.4 AirFlow: Working of principal and construction of different air flow sensors – Anemometer, thermal dispersion flow meter			
2.5 Measurement of CO2 level in air, Clean air, grade of filtration			
3 Microprocessor based DDC Fundamentals in BMS	15	8	**CO1**
3.1 Roll of microprocessor in BMS			
3.2 Evolution of DDC			
3.3 Block diagram of DDC			
3.4 Controller configuration			
3.5 Types of Controller			
3.6 Controller Software i] Operating Software ii] Application software iii] Energy Management Software			
3.7 Typical DDC Operators			
4 HVAC basic concepts	15	10	**CO3**
4.1 Inroduction to HAVC 4.2 Role of HAVC 4.3 Loads on HAVC systems 4.4 Components of HVAC: basic working of heating system and cooling system with basic control , humidification system, de humidification system, air filter system (HEPA and electrostatic types), ventilation with damper setting , AHU (CAV with reheat and VAV types) , block diagram and working of Chiller, cooling tower, boiler 4.5 Types of HAVC systems piping and ducts Features of Single fan dual duct ,two fan dual duct ,two pie system, three pipe system and four pipe system.			
5 HVAC control Loops	15	10	**CO4**
P and ID Diagrams and working of the following loops			
5.1 Preheat coil temperature control loop			
5.2 Heating coil loop with outside air rest			
5.3 Cooling coil temperature control loop			
5.4 Economizer/mixed air temperature control loop			
5.5 Supply and static pressure control loop 5.6 Return air volume control loop			
5.7 Humidity control loop			
Total	**75**	**48**	**-**

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	Number of lectures	Marks
1	**BMS Fundamentals**	10	15
2	**Comfort parameters measurement in BMS system**	10	15
3	**Microprocessor based DDC Fundamentals in BMS**	8	15
4	**HVAC basic concepts**	10	15
5	**HVAC control Loops**	10	15
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	Practical	Marks
1.	Use appropriate sensor and control temperature	
2	Measure humidity	
3	Use dust level sensor	
4	Build and test fire sensors and circuits	
5	Build and test light sensors and circuits	
6	Deploy and operate occupancy sensor circuits	
7	Build and test air flow sensor and circuits	
8	Build and test pressure sensor circuits	
	Total	25

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	Robert McDowall	Fundamentals of HVAC systems	Elsevier

Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	Shan K. Wang	Handbook of air-conditioning and refrigeration	McGraw Hill
2	Roger Haines	HVAC system Design Handbook	McGraw Hill
3	James Brumbaugh	HVAC fundamentals	Audel

ELECTIVE III

(EL622) SUBSTATION PRACTICES

1. COURSE OBJECTIVES

The course contents will help the students understand the concepts and practices followed in the substations so as to enable him/her to work in Substation as Engineer in Operation & Maintenance Department

2. TEACHING AND EXAMINATION SCHEME

Semester	**VI**								
Course code & course title		**Periods/Week (in hours)**			**Total Hours**	**Examination Scheme**			
						Theory Marks		**Practical Marks**	**Total Marks**
(EL622) SUBSTATION PRACTICES		L	T	P	H	TH	TM	TW	PR/OR	
		03	-	02	05	75	25	25	25	150

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

EL622.CO1: Explain functions of various components used in substation including earthing systems

EL622.CO2: Demonstrate Testing of relays and maintenance of substation components.

EL622.CO3: Distinguish between types of substations, bus bar systems, CT & PT. tariffs, types of cables etc.

EL622.CO4: Select power factor correction equipment, size of cable

4. MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation & Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
EL622.CO1	2	-	-	-	-	-	2
EL622.CO2	2	3	2	3	-	3	2
EL622.CO3	3	3	1	1	-	3	2
EL622.CO4	3	3	3	3	3	3	3

Relationship : Low-1 Medium-2 High-3

	PSO1	PSO2
EL622.CO1	1	-
EL622.CO2	2	2
EL622.CO3	2	2
EL622.CO4	3	2

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks | **Thr = Teaching hours** | **CO = Course Objectives**			
Unit	**M**	**Thr**	**CO**
1 INTRODUCTION	**15**	**10**	**CO1, CO3**
1.1Classification of substation, on the basis of services rendered, operating voltage &construction (indoor, outdoor, underground and pole mounted), gas insulated substation & its features, comparison between indoor & outdoor substations. Selection of site for a substation.			
1.2 Function & symbols of – bus bars, circuit breaker , isolators , earthing switch, CT, PT, Line trap, Lighting Arrester ,transformer, Insulator (only Function) Single line diagram of 11 KV/440 V pole mounted substation, 220/110KV Substation, 33/11 KV substation.			
1.3 Control room details: Types of Control panels – corridor type & cubical type, Mimic diagram (connection of isolator, earthing switch & circuit breaker to bus bar). Control and indicating equipment in control panel (Audio and visual)			
2 SUBSTATION COMPONENTS	**27**	**16**	**CO1, CO3, CO4**
2.1 Bus Bars : Arrangement: single bus bar , single bus bar with bus sectionalisation, main & transfer bus bar, double bus bar with 1 breaker, double bus bar with 2 breaker, 1&1/2 breaker, ring main arrangement.			
2.2 CT & PT -Need & Applications of CT , Concept of Ratio error , phase angle error , burden, Definition of composite error, CT construction – wound type, bar type, effect of secondary open circuit, clamp on ammeter, difference between CT for measurement & CT for protection General specifications for procurement Construction of potential transformers, CVT, Difference between C.T. & P.T., General specifications for procurement			
2.3 Lightning Arrestor & Surge Absorber Basic Construction & Working of: horn gap, metal oxide, valve type Lightning Arresters. Surge absorbers: Function , capacitor & reactor type			

2.4 Cables General construction of cable, construction of PVC & XLPE cable (single core). Classification of cables based on voltage & number of cores, Methods of laying cables: Direct laying, Draw in system, Solid system, Their advantages and disadvantages. Factors affecting current carrying capacity. Selection of cable based on current carrying capacity & permissible voltage drop Comparison between power cables & control cables			
3 SUBSTATION EARTHING	9	6	**CO1**
3.1 Description of Earthing mat. Concept of Isolated neutral, grounded neutral. Comparison between grounded neutral & isolated neutral. Permissible values for large, major & small substation Types of neutral earthing: solid grounded, resistance & reactance. concept for step potential & touch potential, methods to reduce them			
4 POWER FACTOR IMPROVEMENT & TARIFF	15	09	**CO1, CO3, CO4**
4.1Power factor improvement Disadvantages of low power factor, causes of low power factor, importance of pf improvement, equipments for pf improvement. (capacitor, synchronous condenser) Calculation of pf correction (Simple numerical).			
4.2 Tariff Objective of tariff, desirable character of tariff. Types – Simple rate tariff, block rate tariff, max. demand Tariff, power factor tariff			
5 MAINTENANCE OF SUBSTATION ACCESSORIES	9	7	**CO2**
5.1Testing of transformer oil, measures to improve quality. Reactivation of silica gel.			
5.2 Batteries: Basic working of lead acid cell, care & maintenance of batteries, hydrometer & its use. Charging methods: Constant voltage, constant current, taper voltage & two rate charging &trickle charging.			
5.3 Safety precautions in carrying out works in substation Importance of work permit			
Total	**75**	**48**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	Number of lectures	Marks
1	INTRODUCTION	10	15
2	SUBSTATION COMPONENTS	16	27
3	SUBSTATION EARTHING	06	9
4	POWER FACTOR IMPROVEMENT & TARIFF	09	15
5	MAINTENANCE OF SUBSTATION ACCESSORIES	07	09
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK

No	Practical (Minimum Eight)	Marks
1.	Testing of Earth Fault relay	
2.	Testing of differential relay	
3.	Testing of CT & PT (ratio & polarity test)	
4.	Testing of over current Relay	
5.	Testing of Overvoltage/ under voltage relay	
6.	Cable acceptance Tests	
7.	Study of pole mounted substation	
8.	Study of 33KV / 11 KV substation (Field visit)	
9.	Study of 220 KV or 110 KV substation (Field visit)	
10.	Cable Fault location testing	
11.	Testing of dielectric strength of transformer oil	
12	Study of Cable Laying Methods	
13	Study of HVDC & Traction Substation	
	Total	25

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	V. K. Mehta	Principles of Power Systems	S. Chand
2	S. Rao	Electrical Substation Practice	Khanna
3	V. K. Jain	Bulk Electric Supply & Distribution	Galgotia Booksource
4	Sharotri	Installation ,Maintenance and Repair of Electrical Machines and Equipments	Katson books

Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	M.P.KRISHNA PILLAI	POWER STATION AND SUB-STATION PRACTICE	STANDARD PUBLISHERS DISTRIBUTORS

Videos and Multimedia Tutorials

S. No.	Author	Title of VEDIO	Publishers
1	NITTTR BHOPAL	PROTECTIVE ZONE	
2	NITTTR BHOPAL	WORK PERMIT	

(EL623) ILLUMINATION ENGINEERING

1. COURSE OBJECTIVES

This subject enables the students to understand the need for good illumination and design the lighting system for a given installation. Students also will be able to do planning, drawing of layout and estimation of quantity of luminaries for a given installation.

2. TEACHING AND EXAMINATION SCHEME

Semester	**VI**								
Course code & course title		**Periods/Week (in hours)**			**Total Hours**	**Examination Scheme**			
						Theory Marks		**Practical Marks**	**Total Marks**
(EL623) Illumination Engineering		L	T	P	H	TH	TM	TW	PR/OR	
		3	-	2	5	75	25	25	25	150

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

EL623.CO1: Explain terms and laws of illumination engineering.
EL623.CO2: Develop the scheme of indoor and outdoor lighting.
EL623.CO3: Compare the luminaries and special features of lighting schemes.
EL623.CO4: Design lighting system for indoor and outdoor type of installation.

4. MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation & Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
EL623.CO1	2	-	-	-	2	-	3
EL623.CO2	3	3	3	3	3	3	3
EL623.CO3	2	3	1	3	2	-	-
EL623.CO4	3	3	3	3	3	3	3

Relationship : Low-1 Medium-2 High-3

	PSO1	PSO2
EL623.CO1	1	-
EL623.CO2	3	-
EL623.CO3	2	2
EL623.CO4	3	2

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	**Thr = Teaching hours**	**CO = Course Objectives**

Unit		**M**	**Thr**	**CO**
1	**INTRODUCTION TO LIGHT**	**15**	**10**	**CO1,CO3**
1.1	Definition of light, white light, natural light, artificial light, supplementary light, qualities of good lighting, factor affecting good lighting – Glare & its types, Hard shadows, soft shadow, contrast & its levels between visual task, working plane, surrounding & field of vision, colour rendering effect & CRI. Reflection factor, types of reflection, stroboscopic effect- its causes & ways to minimize it Definition of terms related to light & its unit of measurement – Luminous flux, Lumens, Luminous intensity, candle power, illumination level, or illluminance, luminance or brightness. Types of candle powers – M.S.C.P, M.H.C.P.MHSCP, efficacy of lamps.			
1.2	Types of lighting systems – Direct, semi direct, indirect, semi indirect, general diffused & mixed diffused & their differentiation w. r. t. luminous efficacy, softness of light, application. reflector, reflector cum diffuse & diffusers used for each lighting system, Types of lighting scheme – general, local & localized, their differentiation			
2	**MEASUREMENT OF LIGHT**	**12**	**8**	**CO1 CO2**
2.1	Laws of illumination – Inverse Square Law & Lambert Cosine Law. Numerical on laws of illumination. Polar Curves – Significance of Polar curve, types of Polar curves,			
2.2	Illumination level & brightness for different types of lighting sources, such as Round source, flat source or tubular source/diffuser. Concept of Downward light output ratio, Upward light output ratio, Light output ratio, Lower Flux utilance , Upper flux utilance, COU (No numerical).			
3	**DESIGN OF INTERIOR LIGHTING**	**18**	**12**	**CO1,CO2 ,CO3,CO 4**
3.1	Design of lighting scheme and factors to be considered while designing lighting scheme Definition of various factors related to interior lighting design:			

maintenance factor, depreciation factor, their selection & range of nominal values. Room Index, Cavity Index, mounting height, suspension height, spacing between two luminaries, Criteria to be used for selection of spacing. Space to mounting height ratio. Nominal range of values of space to mounting height ratio, room index & cavity index, Factors affecting coefficient of utilization & space to mounting height ratio Selection of lamps & luminaries, their methods of mounting, efficacy of lamps/lighting sources & range of their nominal values.			
3.2 Steps in Interior lighting design using Lamp Lumen method, preparation of Layout of luminaires using suitable design numerical.			
4. DESIGN OF OUTDOOR LIGHTING	**24**	**12**	**CO1,CO3 ,CO4**
4.1 Street lighting: Need and criteria for good street lighting, general principles employed in design of street lighting installations, terms related such as carriageway, kerb, outreach, overhang, dual carriage way with diagram. Silhouetting effect. Types of luminaires used their advantages and disadvantages, condition for their usage, Arrangements of Luminaries: - their advantages & disadvantages, Illumination level for street lighting and mounting height of lamps, Selection of mounting heights of luminaries, steps in street lighting design using point by point calculation method			
4.2 Flood lighting Essential features of flood lighting, different types of lamps used in floodlighting, Requirements of flood light projectors. Terms related to flood lighting: beam spread, beam factor & waste light factor, Depreciation factor, coefficient of utilization, Calculation of space to mounting height ratio. Location and mounting of flood Light projector, Aiming of flood light projectors, Steps in design of flood lighting with suitable design Numerical.			
5.OTHER LIGHTING SYSTEMS	**6**	**6**	**CO1,CO3**
Special Features of: Entrance, corridor & staircase lighting, Hospital lighting (Hospital ward lighting, operation theatres Lighting), sports lighting, Auditorium lighting & Spot lighting.			
Total	**75**	**48**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	Number of lectures	Marks
1	INTRODUCTION TO LIGHT	10	15
2	MEASUREMENT OF LIGHT	8	12
3	DESIGN OF INTERIOR LIGHTING	12	18
4	DESIGN OF OUTDOOR LIGHTING	12	24
5	OTHER LIGHTING SYSTEMS	6	6
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK

No	Practical (minimum 8)	Marks
1.	Prepare a detailed report on illumination required and available at different placed in the institute by lux meter.	
2.	Identification of following lamps & study their characteristics, such as operating voltage, efficacy, starting time, restarting time, colour appearance, colour rendering effect, effect of voltage variation on their performance.(a)Incandescent (b) Fluorescent tube, (c) L.P.M.V. lamps, (d) H.P.M.V. Lamp, (e) H. P. S. V. Lamp, (f) LED (g) CFL	
3.	Determine reflection & absorptions factors of various surfaces as polished mirrors, plane glass, frosted glass, opal, polystyrene, acrylic sheets	
4.	Visit to industry to study the lighting system and prepare a report on same	
5.	Visit to indoor sports stadium to study the lighting system and prepare a report on same.	
6.	Visit to outdoor sports stadium to study the lighting system and prepare a report on the same.	
7.	Design a lighting scheme for classroom	
8.	Design a lighting scheme for workshop/ showroom.	
9.	Design a lighting scheme for tennis court/ auditorium etc	
10.	Study of lighting systems for monuments.	
	MARKS	**25**

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	J. B. Gupta	Electrical Installation Estimation & costing	S .K. Kataria &Sons
2	Raina , Bhattacharya	Electrical Design Estimating & costing	New Age International publishers
3	Cayless & Marsden	Lamps & Lighting	New Heights
4	Er.V.K.Jain	Bulk Electric supply and Distribution	Galgotia Booksource Publishers
5	D. C. Prichard	Lighting	

Reference Books for further study

S. No.	Author	Title of Books	Publishers
2	J.B. Gupta	A Course in Electrical Power	S. K. Kataria & Sons

(MC612) PLC IN AUTOMATION

1. COURSE OBJECTIVES:

The subject is classified under automation technology group. The advancement of both knowledge and technique has resulted in the development of PLC's in process industry. Programmable Logic controller works as a brain of automation system, which can be programmed for desired functions for controlling different machines. Therefore, there is demand for persons having automation knowledge with skill of PLC Programming.

2. TEACHING AND EXAMINATION SCHEME

Semester									
Course code & course title	Periods/Week (in hours)			Total Hours	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
	L	T	P	H	TH	TM	TW	PR/OR	
(MC612) PLC IN AUTOMATION	3	-	2	5	75	25	25	25	150

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

MC612.CO1: Describe the various components of PLC.

MC612.CO2: Select different types of input and output for PLC.

MC612.CO3: Develop Ladder Logic Program for a given application.

MC612.CO4: Demonstrate installation and troubleshooting of PLC.

4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation & Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
MC612.CO1	3	2	1	1	1	1	2
MC612.CO2	3	3	1	1	1	1	2
MC612.CO3	3	3	3	3	1	2	2
MC612.CO4	3	3	3	3	2	3	2

Relationship : Low-1 Medium-2 High-3

	PSO1	PSO2
MC612.CO1	1	-
MC612.CO2	1	1
MC612.CO3	3	3
MC612.CO4	3	3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	**Thr = Teaching hours**	**CO = Course Outcomes**			
Unit			**M**	**Thr**	**CO**
1 AUTOMATION			09	04	CO1
1.1 Introduction ed of automation, Advantages of automation, Requirements of automation.					
1.2 Application areas Process industries, Buildings, Robotics, Infrastructure, Aerospace, railways, Automobiles, Telecom, Electrical distribution, Medical.					
2 PLC FUNDAMENTALS			15	12	CO1 CO2
2.1Introduction Evolution of PLC in automation, Difference between Relay control and PLC Control, Advantages, Disadvantages, PLC Vs PC. Different PLC's available in market (Rating,Memory,cost, programming language, performance)					
2.2 Block diagram and description of different parts: CPU – Function, scanning cycle, speed of execution Power Supply- Function Memory- Function and Organisation of ROM and RAM					
2.3 Input and Output Modules Input Modules – Function, different input devices used with PLC (Only name and their Uses) Output Modules- Function, different output devices used with PLC (Only name and their Uses) Fixed and Modular PLCs and their types. Concept of Sink/Source, set/ reset, latch/unlatch					
3 PLC PROGRAMMING			21	13	CO1 CO2 CO3
3.1 Introduction Ladder Diagrams, Flowcharting as a Programming method.					
3.2 Basic Logic Circuits Ladder diagram for basic logic circuits, (AND, OR, NAND, NOR, XOR)					
3.3 Basic PLC Functions PLC Timer Functions, PLC Counter Functions, Register Basics					
3.4 Intermediate Functions Arithmetic Functions, number comparison and number conversion functions					
3.5 Data Handling Functions PLC SKIP, MASTER CONTROL RELAY Functions, JUMP, PLC MOVE Function, PLC FIFO Function. Simple Programming examples using ladder programming language based on logical, comparison, timer, counter, data handling and miscellaneous instruction.					

M = Marks	Thr = Teaching hours	CO = Course Outcomes			
Unit			**M**	**Thr**	**CO**
Unit 4 PLC APPLICATIONS			21	12	CO1 CO2 CO3
4.1 Ladder Programming PLC Applications Block Diagram and Simple Ladder programming for following applications: i) Control of Pneumatic Cylinder: Logical control with and without Latching, Sequential control ii) Elevator Control iii) Conveyor Control iv) Bottle Filling Control v) Stepper motor control					
Unit 5 PLC INSTALLATION AND TROUBLE SHOOTING			09	07	CO1 CO2 CO3 CO4
5.1 PLC Installation PLC Installation: Enclosures, racks, master control relay, grounding, noise suppression, maintenance guidelines.					
5.2 PLC troubleshooting PLC troubleshooting - input and output troubleshooting using module LED status, troubleshooting of ladder program.					
		Total	**75**	**48**	

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	Number of lectures	Marks
1	Automation	04	09
2	PLC Fundamentals	12	15
3	PLC Programming	13	21
4	PLC Applications	12	21
5	PLC Installation and trouble shooting	07	09
	Total	**48**	**75**

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	**Practical** (1 TO 5,10,11 compulsory and Any two from 6 to 9)	**Marks**
1.	Write a Ladder program to verify functions of logic gates by using PLC.	**25**
2.	Write a Ladder Program for start stop using two inputs.	
3	Write a Ladder Program using Output Interlocks	
4	Write a Ladder Program for Traffic control using timer functions.	
5	Write a Ladder Program for pulse counting using Limit switch/proximity sensor.	
6	Write a Ladder Program for PLC based application using Conveyor system.	
7	Write a Ladder Program for PLC based application using Elevator system.	
8	Write a Ladder Program for PLC based application for bottle filling	
9	Write a Ladder program for sequencing of cylinders	
10	Install PLC with input output devices.	
11	Troubleshoot a given PLC configuration.	
	Total	

9. LEARNING RESOURCES

9.1 Text Books

S. No.	Author	Title of Books	Publishers
1	John W. Webb & Ronald Reis	Programmable Logic Controllers	Prentice Hall of India
2	NIIT	Programmable Logic Control – Principles and Applications	Prentice Hall India
3	Madhuchand A. Mitra & Samarjit Sen Gupta	Programmable Logic Controllers and Industrial automation	Penram International Publishing

9.2Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	Petruzella	Programmable Logic Controller	McGgraw Hill
2	Gary Dunning	Introduction to Programmable Logic Control	Cengage Learning
3	V.R Jadhav	Programmable Logic Controllers	Khanna Publishers
4	W. Bolton	Programmable Logic Controllers	Elsvier India;

9.3 Internet and Web Resources

Websites:

www.plctutor.com

www.plcs.net

www.abb.co.in

Students may download the catalogue of PLC from websites of reputed manufacturers such as SIEMENS, FATEK, DELTA, OMRON and ALLEN-BRADLLEY to learn the latest developments.

(EX624) CONSUMER ELECTRONICS

1. COURSE OBJECTIVES:

- Many of the domestic and office gadgets at home and around are electronically controlled. This course on Consumer Electronics will enable students to understand the underlying workingprinciples of many of the electronic devices used in the consumer industry. The student will be able to apply this knowledge to carry out maintenance, fault finding, repairs and servicing of such devices along with laboratory equipments
- The students will able to
  1. To provide fundamental knowledge about the various gadgets of Consumer electronics

2. TEACHING AND EXAMINATION SCHEME

Semester VI									
Course code & course title	Periods/Week (in hours)			Total Hours	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
EX624 Consumer Electronics	L	T	P	H	TH	TM	TW	PR/OR	
	03	-	02	05	75	25	25	25	150

3. COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

EX624.CO1: Understand the electronics engineering concepts used in consumer electronics
EX624.CO2: Identify the working of various consumer electronic devices used as office gadgets
EX624.CO3: Examine the working of various consumer electronic devices such as washing machine, AC's, Microwave ovens with sketches of the block diagram.
EX624.CO4:. Discuss the need of preventive maintenance and safety measures in various electronic appliances

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4. Mapping Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline Specific Knowledge	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation & Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
EX624.CO1	2	2	2	-	-	-	3
EX624.CO2	2	1	2	2	2	-	3
EX624.CO3	2	-	1	2	2	2	3
EX624.CO4	3	3	3	3	2	-	3

Relationship : Low-1 Medium-2 High-3

	PSO1	PSO2
EX624.CO1	1	-
EX624.CO2	2	2
EX624.CO3	3	3
EX624.CO4	3	3

7. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks	**Thr = Teaching hours**	**CO = Course Objectives**	

Unit	**M**	**Thr**	**CO**
1 Electronically controlled low power Home appliances	**16**	**10**	**CO1,CO2**
1.1 Digital Clock:- Detailed block diagram, working 1.2 Digital Calculator:- Structure of Calculator, Block diagram of Calculator, Working 1.3 Digital Thermometer:- , Block diagram of Digital thermometer, Working, Advantages ,Applications 1.4 Digital Weighing Machines:- , Block diagram of Digital weighing machine, Working, Applications, Comparison of Mechanical and Electronic Weighing Machines.			
2 Electronically controlled High power Home appliances	22	14	**CO1,CO3**
2.1 Microwave Oven:- Microwaves, Advantages of microwaves over conventional electrical heating system, working principle, Microwave oven functional block diagram, Safety instructions for Microwaves. 2.2 Washing Machines:- working principle, Electronic controller for washing machines, Washing machine hardware and washing cycle. Introduction to types of washing machines---Semi automatic , Fully automatic, Fuzzy logic washing machines. 2.3 Air conditioning :- Introduction to Air Conditioning, Components of Air Conditioning systems, All water Air Conditioning systems, All air Air conditioning systems ,Introduction to unitary and Central Air conditioning systems and Split Air conditioner 2.4 Refrigerators:- Refrigeration ,Vapour Compression Refrigeration System, Domestic Refrigerator 2.5 Voltage Stabilizers:-Introduction to voltage Stabilizer, Need for voltage stabilizer, Need for voltage stabilizer, Specifications,Working of basic Series stabilizer.			
3 Electronically controlled Entertainment, Commercial and surveillance appliances	**18**	12	**CO1,CO3**
3.1 Digital Camera:- Working principle of digital camera,Techanical specifications Features of typical Electronic Surveillance system 3.2 Bar codes:- Introduction to Bar codes, Bar code formats(UPC and AIAC) , Barcode scanner and decoder 3.3Xerography:- Operation of photocopier			
3.4Metal detector :- Working and Applications*(LEVEL4)*			

4 Electronically controlled Communication appliances	13	08	**CO1,CO3**
4.1 Cordless phones:- Transmitter section and Receiver Section 4.2 EPABX System :- Block diagram and working			
4.3 Public Addressing System*(LEVEL4)*			
5 Maintenance and safety Precautions	06	04	**CO4**
5.1 Electricity in home, Dangers of electricity, Safety Precautions, Hazards associated with electric current voltage, Approaches to prevent accidents, Fire prevention and fire fighting.			
Total	**75**	**48**	-

6. COURSE DELIVERY:

The Course will be delivered through lectures, class room interactions, exercises and case studies

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSON PLAN

Unit No	Unit	Number of lectures	Marks
1	**Electronically controlled low power Home appliances**	10	16
2	**Electronically controlled High power Home appliances**	14	22
3	**Electronically controlled Entertainment ,Commercial and surveillance appliances**	12	18
4	**Electronically controlled Communication appliances**	08	13
5	**Maintenance and safety Precautions**	04	06
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	Practical	Marks
1.	Use of Test and Measurement Instruments and Interpretation of manuals of CRO,Multimeter,Power Supply, and Function Generator	
2	Identification and testing of different types of components such as Resistors,Capacitors,Diodes,Transistors,Switches and Relays	
3	Soldering and Desoldering	
4	Explore the various functions of Washing machines and locate various sensors used in that washing machines	
5	Check the wiring of ACs and explore all functions	
6	Test various functions of Microwave ovens	
7	Explore settings Digital Cameras	
8	Demonstration of Photocopy Machine	
9	Demonstration of EPABX system	
10	Demonstration of CCTV Or simple Public address system	
	Total	25

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	S.P.Bali	Consumer Electronics	Pearson Education
2	B.R. Gupta and V. Singhal	Consumer Electronics	New Age International Publisher

Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	J S Chitode	Consumer Electronics	Technical Publications Pune