SEMESTERVI

(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	2	2
EL601.CO2	3	3
EL601.CO3	3	3
EL601.CO4	3	3

4. 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	

5. COURSE DELIVERY:

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

6. 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**

7. 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

8. 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

(EL602) PROJECT

1. COURSE OBJECTIVES:

This is intended to integrate several skills and competencies which have been developed in thestudents 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 organizesolution for the problem

EL602.CO3: Collect, analyze and test data relevant to problem

EL602.CO4: Develop leadership, soft skills & teamwork to design , execute hardware/softwareand 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	3
EL602.CO2	3	3
EL602.CO3	3	3
EL602.CO4	3	3

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

(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
CC501.CO1	2	2
CC501.CO2	2	2
CC501.CO3	2	2
CC501.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/moviesSuggested 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/338061

26.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 Knowledge	Problem Analysis	Design and Devlopment of Solutions	Engg. Tools, Experimentatn& 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	1	1
CC601.CO2	2	2
CC601.CO3	2	2
CC601.CO4	2	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, 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	21	14	CO1CO2 CO3CO4
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 carryingout 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	3	3
EL618.CO2	3	3
EL618.CO3	3	3
EL618.CO4	3	3

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 (NoNumericals): 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 energyperformance 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	2	2
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 CO3C O4
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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(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 substationincluding earthingsystems

EL622.CO2: Demonstrate Testing of relays and maintenance of substation components.
EL622.CO3: Distinguish between types of substations, bus bar systems, CT & PT. tariffs, typesof 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	2	2
EL622.CO2	3	3
EL622.CO3	3	3
EL622.CO4	3	3

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.					
2.2CT& 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					
2.3Lightning Arrestor & Surge Absorber Basic Construction & Working of: horn gap, metal oxide, valve type Lightning Arresters. Surge absorbers: Function , capacitor & reactor type					

2.4Cables 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).			
4.2Tariff 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	GalgotiaBooksource
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	

(EX617) MOBILE COMMUNICATION

1. COURSEOBJECTIVES:

The students will able to:

i. Understand the basic cellular communicationconcepts
ii. Describe various features & services provided by GSM &CDMA
iii. Understand features of modern cellularsystem.

2. EACHING AND EXAMINATIONSCHEME

Semester VI									
Course code & course title	Periods/Week (in hours)			Total Hours	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
(EX617) Mobile Communication	L	T	P	H	TH	TM	TW	PR/OR	
	3	-	2	5	75	25	25	25	150

3. COURSEOUTCOMES:

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

EX617.CO1: Describe the concepts, components & processes used in cellular communication EX617.CO2: Differentiate various multiple access techniques, cellular systems & handoffs used in cellular

communication

EX617.CO3: Apply the concepts of Cellular Communication to describe various processes in ofGSM & CDMA

Ex617.CO4: Analyze the features of various cellular communication systems

4. Mapping Course Outcomes with ProgramOutcomes

	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
EX617.CO1	2	2	2	-	1	2	3
EX617.CO2	3	2	2	-	-	1	2
EX617.CO3	2	2	2	1	1	2	3
EX617.CO4	2	3	1	-	2	-	3

Relationship : Low-1 Medium-2 High-3

	PSO1	PSO2
EX617.CO1	2	1
EX617.CO2	2	2
EX617.CO3	2	2
EX617.CO4	2	2

5. DETAILED COURSE CONTENTS / MICRO-LESSONPLAN

M = Marks	**Thr = Teaching hours**	**CO = Course Objectives**		
Unit			**M**	**Th R**	**C O**
1 Introduction to Cellular CommunicationSystems			24	16	CO1 CO2
1.1 Need of Mobile telephone system, ConventionalMobile telephonesystem & itslimitations					
1.2 Analog & digital cellular system : Brief comparison					
1.3 A basic cellular system: Diagram & operation of each subsystem					
Cellular communicationConcepts: • Cell, Cellgeometry • Frequency reuse concept, frequency reuse schemes, frequency reusedistance • Co-channel interference & adjacent channel interference(definitions) • Co-channel reductionfactor • Cell splitting: need & types, sectoring, segmentation& dualization Handoff: need, types (based on signal strength and C/I ratio),delayed handoff, power difference handoff, mobile assisted handoff , soft handoff & Intersystem handoff.(No Mathematical Treatment)					
2 Components and Working Principle Of Cellular Communication Systems			15	09	C O1 C O2 C O3
2.1 Components of cellular communication system: Base station, MTSO, Mobile handset (Block Diagram Operation).					
2.2 Processes: Logon & Monitoring Process in cellular system					
2.3 Routing cellular calls: mobile to land line, landline to mobile, mobile to mobile & handoff mechanism.					
2.4 Frequency spectrum utilization, Setup Channels: Access & Paging Channels					
2.5 Multiple access techniques: Basic concepts & features of FDMA,TDMA& CDMA					

3 Digital Cellular system-GSM	09	06	CO2 CO3 CO4
Global system formobile(GSM): • Services &Features • Architecture & Operationofeach subsystem • Frequency channels(TCHs,CCHs inbrief) • Location updatemanagement • Authentication & encryption			
4 Digital Cellular system-CDMA	09	06	CO2 CO3 CO4
CDMA cellularsystem: • Services &Features • Radio aspects, forward channel structure and reverse channelstructure • Powercontrol • Softhandoff • Authentication, encryption andprivacy			
5 Modern cellular systems	18	11	CO2 CO4
5.1 Limitations of 2G Cellular System			
5.2 Features of 2.5G Cellular system, Features of EDGE and GPRS Systems			
3G technology networks: Featuresof • CDMA-2000 • WCDMA(UMTS). • Wireless Local area network(WLAN) • Bluetooth & Personal AreaNetworks(PANS)			
5.4 Features of 4G cellular system , Comparison of 3G & 4G cellular system			
Overview of 5G cellularsystem: • PerformanceTargets • Usage Scenario: Enhanced Mobile Broadband (eMBB),Ultra Reliable Low LatencyCommunications (URLLC), Massive Machine Type Communications (mMTC) • Advantages of5G			
Total	**75**	**48**	

6. COURSEDELIVERY:

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

7. SPECIFICATION TABLE FOR THEORY/ MACRO-LESSONPLAN

Unit No	Unit	Number of lectures	Marks
1	Introduction to Cellular CommunicationSystems	16	24
2	Components and Working Principle of Cellular Communication Systems	09	15
3	Digital Cellular system-GSM	06	09
4	Digital Cellular system-CDMA	06	09
5	Modern cellular systems	11	18
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALSHOURS

No	Practical	Marks
1.	Study the features, specification and block diagram operation of mobile Handset	
2.	Identify various sections of a mobile handset (hardware)	
3.	Measure/Observe signals at different sections of Mobile Phone	
4.	Identify various hardware faults in a mobile handset	
5.	Study of various software faults in a mobile handset	
6.	Comparision of GSM & CDMA cellular technology	
7.	Study the concept of Bluetooth & Wi-Fi(WLAN)	
8.	Study of advancement in modern Cellular communication systems	
9.	Visit to GSM /CDMA Base station (Optional)	
	Total	25
No	**Class room Assignments**	**Marks**
1	At least 2 assignments	

9. LEARNING RESOURCES

TextBooks

S. No.	Author	Title of Books	Publishers
1	William Lee	Mobile cellular telecommunications	McGraw Hill ISBN 978-0-07-063599-9
2	Theodore s. Rappaport	Wireless communications- Principles & Practice	Prentice Hall of India ISBN 81-203-2381-5
3	Raj Pandya	Mobile & Personal Communication systems & services	Prentice Hall ofIndia ISBN81-203-1710-6
4	Wayne Tomasi	Advanced Electronic Communication systems	Pearson Education ISBN 81-297-0107-3

Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	T.G.palanivelu& R.Nakkeeran	Wireless & Mobile Communication	PHI learning pvt ltd ISBN 978-81-203-3607-0
2	Rishabh Anand	Wireless Communication	S.Chand& company Ltd. ISBN 81-219-4055-9

Internet and Web Resources

1	https://en.wikipedia.org/wiki/5G
2	https://www.zdnet.com/article/what-is-5g-everything-you-need-to-know/
3	https://pdfs.semanticscholar.org/b2ab/1c503c76a4b3870feaec5c3a6a157972a555.pdf

ELECTIVE III

(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 knowledgewith 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
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	2	2
MC612.CO2	2	2
MC612.CO3	3	2
MC 612.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.					
Unit 4 PLC APPLICATIONS					

4.1 Ladder Programming PLC Applications Block Diagram and Simple Ladder programming for following applications:	21	12	CO1 CO2

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

Unit	**M**	**Thr**	**CO**
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			CO3
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.co

m 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.

EX631 TV ENGINEERING

1. COURSE OBJECTIVES :

The Course will introduce the students with working principle,block diagrams of sound transducers,B/W &colour TV ,LCD,LED TV,CCTV,DTH,HDTV,cable TV so that they will beable to install,test& troubleshoot simple faults in audio & Video equipments.

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
EX631 TV Engg.		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:

EX631.CO1: Understand various concepts and characteristics of Audio Transducers.

EX631.CO2: Describe applications of TV such as CCTV,CATV,HDTV,DTV,DTH,LCD & LEDTV.

EX631.CO3 Differentiate between various audio & Video recorder formats..EX631.CO4: Analyze and compare B/W &colour TV 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	Problem Analysis	Design and Devlopment of Solutions	Engg. Tools, Experimentation& Testing	Engg. Practices for Society,Sustainability& Environment	Project Management	Life -long Learning
EX631.CO1	2	-	-	3	-	-	3
EX631.CO2	2	1	-	3	-	-	-
EX631.CO3	2	-	2	-	-	3	3
EX631.CO4	2	1	2	3	-	2	3

Relationship :Low-1 Medium-2 High-3

	PSO1	PSO2
EX631.CO1	2	2
EX631.CO2	2	2
EX631.CO3	3	2
EX631.CO4	3	3

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks | **Thr = Teaching hours** | **CO = Course Objectives**			
Unit	**M**	**Thr**	**CO**
1 SOUND TRANSDUCERS	**15**	**9**	**1**
1.1 Characteristics: sensitivity, signal to noise ratio, directivity, output impedance, distortion and frequency response			
1.2 Requisites of a good microphone. Construction, functioning, features, and applications of microphones: Crystal, Moving coil. And Electret.			
1.3 LOUD SPEAKERS**:**Characteristics of loudspeaker Working principles of horn type and electrodynamic type loudspeaker Baffles(Finite,infinite ,bassreflex& acoustic labryinth) &Enclosure,Multiway speaker system (Woofers & Tweeters),surround sound system(block diagram)			
2 TV COMMUNICATION SYSTEM	18	12	**4**
2.1 TV PICTURE ANALYSIS: -Frequency range of various VHF/UHF band, Aspect ratio, Persistence of vision.			
2.2 Scanning: Need, Sequential scanning, flicker, interlaced scanning,interlaceerror,interlace error calculation, horizontal scanning, vertical scanning			
2.3 Composite Video Signal (CVS) .need for synchronization,Horizontal sync and blanking pulses, Vertical sync and blanking,(No equalizing pulses).			
2.4 TV Camera tube: Characteristics of camera tube, construction and working of vidicon			
2.5 VSB Modulation			
3 COLOUR TELEVISION	18	10	**4**
3.1Compatibility of color TV system with monochrome system.			
3.2 Additive and subtracting mixing of colors, luminance, Hue and Saturation			
3.3 Block diagram of video camera and its explaination			
3.4 Construction and working principles of Trinitron picture tube.			

3.5 Colour signal transmission,signal modulation, transmission, bandwidth,weighing factors & chrominance signal			
3.6 Block diagram of PAL TV transmitter & receiver.			
4 TYPES OF TV & APPLICATIONS	15	11	**3**
a. Introduction to DIGITAL TV (DTV):Advantageous (picture quality,specialfeatures,specialeffects,high reliability) Digital Video production & Reproduction (Block Diagram) Digital picture transmission & Reception (Block Diagram) Picture in picture feature in DIGITAL Principles of working HDTV			
4.2 Principle of working ,features& Block diagram of Cable TV, PAY TV			
THROUGH CABLE,CCTV and DTH.			
4.3 LCD TV & LED TV :Introduction& block diagram			
4.4 Night vision camera			
5 VIDEO RECORDING & PRODUCTION	9	6	**3**
5.1 Comparision VCD virses DVD			
5.2 DVD formats, recording and playback on DVD			
5.3 Introduction to BLU-RAY DISC, Block diagram BD player & operation			
5.4 Comparision of BLU-RAY &DVD			
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	Sound Transducers	9	15
2	TV Communication system	12	18
3	Colour Television	10	18
4	Types of TV & Applications	11	15
5	Video Recording & Production	6	9
	Total	48	75

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	Practical	Marks
1	Test performance of pattern generator.	
2	Compare composite video signal (B/W) of different patterns	
3	Test performance of picture tube (B/W).	

4	Compare composite video signal (colour) of different patterns.	
5	. Test performance of TV receiver controls	
6	Test performance of picture tube (colour)	
7	Tracing of different sections of TV receiver	
8	Location of faults in the different sections of TV receiver	
9	. Study of a TV cable network system through internet	
10	Study of a CCTV system through internet	
No	**Class room Assignments**	**Marks**
1	At least 2 assignments	

9. LEARNING RESOURCES

Text Books

S. No.	Author	Title of Books	Publishers
1	R.R Gulati	Modern Television Practice Principles,Technology and Servicing 2/Ed	New age Internationl Publisher, New Delhi **ISBN-** 9788122413601
2	. R.R Gulati	Composite Satellite & cable Television	New age Internationl Publisher, New Delhi **ISBN-** 9788122413601
3	A.M.Dhake	TV and Video Engineering	TMH Publication, New Delhi **ISBN**: 9780074601051
4	Gordon J King	Audio Handbook	Newnes-Butterworth **ISBN-13:**9780408001502
5	Maini	Colour T.V. and Video Technology	PHI Publications. New Delhi
6	K.D. Desai,	Video Cassette Recorders	Jeevan Deep Prakashan, Mumbai, 2nd , 1988
7	Ibrahim, K.F. Newnes	Guide to Television and Video Technology, Fourth Edition	Newnes-Butterworth **ISBN-13:** 9780750681650
8	John D. Lenk	Complete Guide To Laser Video Disc	PHI Publications. New Delhi, 2nd, 1995
9	R.G.Gupta (for unit 4 &5)	Television Engineering and video systems . second edition	second edition ,MH New Delhi

10	LCD LED Screen Panel Repair Guide	http://lcdrepairguide.com/screen-repair/	

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.

EX6244.CO4:. Discuss the need of preventive maintenance and safety measures in various electronicappliances

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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	2	2
EX624.CO2	3	3
EX624.CO3	3	3
EX624.CO4	3	3

5. 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

EX628 VLSI Design and Application

1. COURSE OBJECTIVES :

The Student will be able to :

1. Implement functions using MOS logic following prescribed design rules through mask layouts
2. Develop and model simple MOS circuits through programming

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
EX628 VLSI Design and Application		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:

EX628:CO1: Understand the technologies/ processes involved in fabrication of ICs, operation of MOS devices, design rules, modeling commands and the complete VLSI design flow EX628.CO2: Apply the knowledge of MOS devices to explore channel length modulation, logic design, circuit modeling and design analysis.

EX628.CO3: Analyze the operation of MOS circuits, Implementation of Boolean functions,modeled circuits and VLSI design stages.
EX628.CO4: Evaluate and Select suitable MOS invertors, design implementation and programmableplatforms based on comparative performance and 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	Problem Analysis	Design and Development of Solutions	Engg. Tools, Experimentation & Testing	Engg. Practices for Society, Sustainability & Environment	Project Management	Life -long Learning
EX628.CO1	3	-	1	-	2	-	2
EX628.CO2	3	2	3	2	-	2	-
EX628.CO3	3	2	1	2	-	2	3
EX628.CO4	3	3	3	1	2	2	3

Relationship :Low-1 Medium-2 High-3

	PSO1	PSO2
EX628.CO1	2	2
EX628.CO2	2	2
EX628.CO3	2	2
EX628.CO4	2	2

5. DETAILED COURSE CONTENTS / MICRO-LESSON PLAN

M = Marks | **Thr = Teaching hours** | **CO = Course Outcomes**			
Unit	**M**	**Thr**	**CO**
1 INTRODUCTION TO TECHNOLOGIES IN IC FABRICATION	**15**	**08**	**CO 1**
1.1 Silicon Semiconductor Technology : Concept of wafer processing, oxidation, epitaxy, deposition, etching in chip fabrication.			
1.2 Description of processes such as Photolithography, Ion Implantation and Diffusion			
1.3 CMOS Technology: Description of n-well and p-well CMOS processes			
1.4 Introduction to Impact of chip fabrication on environment and solutions			
2 MOS TRANSISTORS	**15**	**10**	**CO1/ 2/3/4**
2.1 Operation and V I Characteristics of NMOS transistor (Enhancement & Depletion types)			
2.2 Operation and V I Characteristics of PMOS transistor (Enhancement & Depletion types)			
2.3 Description of channel length modulation			
2.4 Concept of CMOS transistor, Operation of a CMOS Inverter with DC characteristics, Comparison of CMOS inverter with NMOS inverter and resistive load MOS inverter.			
3 VLSI LOGIC DESIGN	**15**	**10**	**CO1/ 2/3/4**
3.1 Definition of fan in and fan out, Concept of pass transistor, Implementation of logic gates (OR, AND, NOR and NAND) using pass transistors and CMOS Logic			
3.2 Implementation of simple Boolean expressions using pass transistors and CMOS logic, Comparison of design implementations			
3.3 Study of lambda rules and magic layout editor			

3.4 Drawing of Stick diagrams			
3.5 Drawing of mask layouts with concept of Euler paths			
4 INTRODUCTION TO SPICE	**12**	**08**	**CO1/ 2/3/4**
4.1 Introduction to SPICE Programming commands			
4.2 Modeling of MOS circuits using SPICE (level 1 model equations)			
5 VLSI DESIGN METHODOLOGIES AND APPLICATIONS	**18**	**12**	**CO1/ 2/3/4**
5.1 Description of VLSI Design flow, Brief description of design analysis and its types (circuit and logic), Brief description of design simulation and its types (circuit, timing, switch level and gate level, Brief description of design verification and its types (electrical, timing and functional)			
5.2 General test procedure of an IC, Scan based test, boundary scan design, built in self test (BIST), Automatic test pattern generation			
5.3 fault model (stuck at 1 and stuck at 0 fault modeling)			
5.4 Features and Working of FPGA and CPLD, Comparison between them.			
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 TECHNOLOGIES IN IC FABRICATION**	08	15
2	**MOS TRANSISTORS**	10	15
3	**VLSI LOGIC DESIGN**	10	15
4	**INTRODUCTION TO SPICE**	08	12
5	**VLSI DESIGN METHODOLOGIES AND APPLICATIONS**	12	18
	Total	**48**	**75**

8. SPECIFICATION TABLE FOR TERM WORK & PRACTICALS HOURS

No	Practical	Marks
1.	V I Characteristics of N MOS Transistor	
2.	DC Characteristics of CMOS Inverter	
3.	Mask Layout for logic gates with lambda rules using CMOS logic in Magic Editor	
4.	Mask Layout for Boolean Expressions using CMOS logic in Magic Editor	
5.	Study of commands in SPICE with hands on practice	
6.	Modeling of logic gates using SPICE	
7.	Modeling of Boolean Expressions using SPICE	
8.	Implementation of logic gates using FPGA	
	Total	25
No	**Class room Assignments**	**Marks**
1	At least 2 assignments	

9. LEARNING RESOURCES :Text Books

S. No.	Author	Title of Books	Publishers
1	Sung-Mo Kang, Yusuf Leblebici	CMOS Digital Integrated Circuits Analysis & Design	Mc Graw Hill Education
2	Neil H. E. Weste, David Harris	CMOS VLSI design-A circuit and systems Perspective	Pearson Education
3	Jan M Rabaey	Digital Integrated Circuits- A design Perspective	Pearson Education
4	Douglas Pucknell, Kamran Eshraghian	Basic VLSI design	PHI
5	Wayne Wolf	Modern VLSI Design	Prentice Hall

Reference Books for further study

S. No.	Author	Title of Books	Publishers
1	J Bhaskar	VHDL Primer	PHI
2	Eugene D. Fabricius	Introduction to VLSI Design	Mc. Graw Hill Education
3	Stephen Brown, ZvoncoVranesic	Fundamental of Digital Logic with VHDL design	Mc Graw Hill Education