CURRICULUM

DIPLOMA

Electrical and Electronics Engineering

(Three-year program-semester system)

Council for Technical Education and Vocational Training

Curriculum Development and Equivalence Division

Sanothimi, Bhaktapur

2013

First Revision 2019

Second Revision 2022

Contents

Introduction

Electrical and Electronics Engineering is one of the prominent and popular disciplines within engineering. Many people in the developed countries, developing countries and under developed countries have given emphasis for the broader application of electricity. This field has been helping the world for the technological development and it has been creating wage and self-employment opportunities both in public and private sectors. This curriculum is designed with the purpose of producing the middle level technical workforce equipped with knowledge and skills related to the field of Electrical and Electronics engineering so as to meet the demand of such workforce in the country to contribute in the national economic development of Nepal. The knowledge and skills incorporated in this curriculum will be helpful to deliver the individual needs as well national needs in the field of Electrical and Electronics Engineering.

Rationale of Revision

Electrical and Electronics Engineering is a constantly changing and a rapidly evolving industry, promising a wide range of opportunities. So, it was revised to apply that technology in the courses and make them more relevant. Most modern businesses and industry need people with specific skills and knowledge to support in the workplace.

Medium level workforce of Electrical and Electronics Engineering is highly demanded in Nepali market so they are prioritized with change in workload in the revision. It needed to revise the curriculum to accumulate them according to the changing technology and link them with the world of work as well as higher studies. The rationale behind its revision are as follows:

- The implementing agencies/college have requested to revise this curriculum based on their teaching experiences.
- All Diploma level Engineering Courses' first and second semester subjects are re-adjusted and are common.
- The semester-wise re-adjustments of the existing subjects are felt necessary.
- It is needed to revisit its weightage in both theory and practical marks contents to make it more practical oriented.
- The technologies invented in this field seems necessary to be incorporated.

Curriculum Title

Diploma in Electrical and Electronics Engineering

Aim

The program aims to produce mid-level technical human resource equipped with knowledge and skills in allied field of study.

Objectives

This curriculum has the following objectives:

- Prepare mid-level competent workforce in the related field.
- Prepare technicians who are capable of undertaking works in the industrial settings of electrical and electronics engineering.
- Supply the demand of required electrician for the domestic/industrial infrastructure development sector.

- Prepare technical workforce who will demonstrate professional integrity and respect for the clients with high socio-cultural values;
- Create wage and self-employment opportunities in related discipline.
- Produce middle level competent technical workforce/human resources that could provide supervisory works of electrical engineering;
- Create self-employment opportunities

Group Size

The group size is maximum of 48.

Entry Qualification

- SLC pass or SEE or equivalent with minimum C Grade (2.0 Grade Point) in Mathematics and Science and 1.6 Grade Point or equivalent in English and as per the provisions mentioned in the admission guidelines of Office of the Controller of Examinations, CTEVT.
- Pre-diploma in related subject or equivalent with minimum 68.33%.
- Pass entrance examination administered by CTEVT.

Duration

The total duration of this curricular program is three academic years [six semesters]. The program is based on semester system. Moreover, one semester consists of 19.5 academic weeks including evaluation period. Actual teaching learning Hrs. will be not less than 15 weeks in each semester.

Medium of Instruction

The medium of instruction is in English and Nepali.

Pattern of Attendance

Minimum 90% of attendance in each subject is required to appear in the respective final examination.

Teacher (Instructor) and Student Ratio

- Overall ratio of teacher and student must be 1:12 (at the institution level)
- 1:48 for theory and tutorial classes
- 1:12 for practical/demonstration
- 1:8 for bench work
- 75 % of the technical teachers must be full timer

Qualification of Instructional Staff

- The program coordinator should be a master's degree holder in the related subject area.
- The disciplinary subject related teachers should be a bachelor’s degree holder in the related subject area.
- The demonstrators should be a bachelor’s degree holder or diploma or equivalent with 3 years’ work experience in the related subject area.
- The foundational subject related teacher (refer to course codes SH and MG) should be master’s degree holder in the related subject area.

Instructional Media and Materials

The following instructional media and materials are suggested for the effective instruction and demonstration.

- ***Printed media materials:*** Assignment sheets, case studies, handouts, performance checklists, textbooks etc.
- ***Non-project media materials:*** Displays, models, photographs, flipchart, poster, writing board etc.
- ***Projected media materials****:* Slides, Multimedia Projector.
- ***Audio-visual materials:*** Audiotapes, films, slide-tapes, videodisc, etc.
- ***Computer based instructional materials:*** Computer based training, interactive video etc.
- **Web-Based Instructional Materials** (Online learning)
- **Radio/Television/Telephone**
- **Education-focused social media platform**

Teaching and Learning Methodologies

The methods of teaching will be a combination of several approaches, such as Illustrated talk, Lecture, Tutorial, Group Discussion, Demonstration, Simulation, Guided practice, Practical experiences, Fieldwork, Report writing, Term paper presentation, Case analysis, Tutoring, Role-playing, Heuristic, Project work and Other Independent learning.

- Theory: Lecture, Discussion, Seminar, Interaction, Assignment, Group work.
- Practical: Demonstration, Observation, Guided practice, Self-practice, Project work.
- Internship: Industrial practice

Approach of Learning

There will be inductive, deductive and learner-centered approaches of learning.

Examination and Marking Scheme

A. Internal assessment

- There will be a fair formative evaluation for each subject both in theory and practical exposure.
- Each subject will have internal assessment (terminal tests) at regular intervals and students will get the feedback after each test.
- Weightage of theory and practical marks are mentioned in course structure.
- Formats for continuous assessment will be developed and applied by the evaluators of the related institute following the CTEVT guidelines.
- Students will be allowed to appear in the final examination only after completing the internal assessment requirements.

B. Final summative evaluation

- Weightage of theory and practical marks are mentioned in course structure.
- Students must pass in all subjects both in theory and practical for certification. If a student does not qualify in any subject for final evaluation, s/he will appear in the re-examination administered by CTEVT.

C. Requirement for final practical examination

- Instructors of respective subject must evaluate final practical examinations.

- One evaluator in one sitting can evaluate not more than 24 students.
- Practical examination should be administered in actual situation on relevant subject with the provision of at least one internal evaluator from the concerned or affiliating institute led by external evaluator nominated by CTEVT.
- Provision of re-examination will be as per CTEVT examination guidelines.

D. Final practicum evaluation will be based on:

- Institutional practicum attendance - 10%
- Logbook/Portfolio/Practicum diary maintain - 10%
- Spot performance (assigned task/practicum performance/identification/arrangement preparation/measurement) - 40%
- Viva-voce:
  - Internal examiner - 20%
  - External examiner - 20%

E. Pass marks:

- The students must secure minimum 40% marks in theory and 50% marks in practical in core subjects to pass the exam.
- Moreover, the students must secure minimum pass marks in the internal assessment and in the final examination of each subject to pass the respective subject.

Provision of Back Paper

There will be the provision of back paper but a student must pass all the subjects of all semesters within six years from the enrollment date; however, there should be provision of chance exam for final year students as per CTEVT examination guidelines.

Disciplinary and Ethical Requirements

- Intoxication, insubordination or rudeness to peers will result in immediate suspension followed by the review of the disciplinary review committee of the institute/school.
- Dishonesty in academic or practical activities will result in immediate suspension followed by administrative review, with possible expulsion.
- Illicit drug use, bearing arms in institute/school, threats or assaults to peers, faculty or staff will result in immediate suspension, followed by administrative review with possible expulsion.

Grading System

The following grading system will be adopted:

Grading	**Overall marks**
• Distinction:	80% and above
• First division:	65% to below 80%
• Second division:	50% to below 65%
• Pass division:	Pass marks to Below 50%

Certificate Awarded

- Students who have passed all the components of all subjects of all six semesters are considered to have successfully completed the course.
- Students who have successfully completed the course will be awarded with a degree of **Diploma in Electrical and Electronics Engineering**.

Career Path

The graduates will be eligible for the position equivalent to Non- gazette 1st class/Level 5 (technical) as prescribed by the Public Service Commission of Nepal and other related agencies.

General Attitudes Required

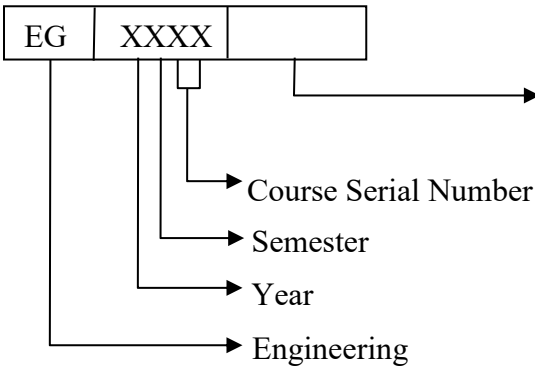
A student should demonstrate following general attitudes for effective and active learning.
Acceptance, Affectionate, Ambitious, Aspiring, Candid, Caring, Change, Cheerful, Considerate, Cooperative, Courageous, Decisive, Determined, Devoted, Embraces, Endurance, Enthusiastic, Expansive, Faith, Flexible, Gloomy, Motivated, Perseverance, Thoughtful, Forgiving, Freedom, Friendly, Focused, Frugal, Generous, Goodwill, Grateful, Hardworking, Honest, Humble, Interested, Involved, Not jealous, Kind, Mature, Open minded, Tolerant, Optimistic, Positive, Practical, Punctual, Realistic, Reliable, Distant, Responsibility, Responsive, Responsible, Self-confident, Self-directed, Self-disciplined, Self-esteem, Self-giving, Self-reliant, Selfless, Sensitive, Serious, Sincere, Social independence, Sympathetic, Accepts others points of view, Thoughtful towards others, Trusting, Unpretentiousness, Unselfish, Willingness and Work-oriented.

Provision of Elective Subjects

There will be a provision of one elective subject in the final semester of this curriculum. Subjects of Electrical and Electronics Engineering discipline such as Broadcast Engineering, Electrical Energy Management, Internet/Intranet, Satellite Communication, Hydropower is offered as an elective. Forty percent students out of total number of enrolled students should be maintained in elective subject.

Subject Codes

Each subject is coded with a unique number preceded and followed by certain letters as mentioned in the following chart:



Offering Departments:

AE: Automobile Engineering
AGE: Agricultural Engineering
AR: Architecture Engineering
BM: Biomedical Engineering
BM: Biomedical Equipment Engineering
CE: Civil Engineering
CT: Computer Engineering
EE: Electrical Engineering
EEX: Electrical & Electronics Engineering
EX: Electronics Engineering
GE: Geomatics Engineering
HE: Hydropower Engineering
IT: Information Technology
ME: Mechanical Engineering
MG: Management
MX: Mechatronics Engineering
RAE: Refrigeration & Air Conditioning Engineering
SH: Science and Humanities

Curriculum Structure
Diploma in Electrical and Electronics Engineering

Year: I **Part: I**

S.N.	Code No.	Subject	Teaching Scheme						Examination Scheme						Total Marks	Remarks
			Mode				Weekly Hours	Credit Hours	DISTRIBUTION OF MARKS							
									Theory			Practical				
			L	T	P	Lab			*Assmt. Marks	Final		*Assmt. Marks	Final			
										Marks	Time (Hrs.)		Marks	Time (Hrs.)		
1	EG1101SH	Applied Nepali	4				4	4	20	80	3				100	*Continuous assessment
2	EG1102SH	Applied English	4				4	4	20	80	3				100	
3	EG1103SH	Engineering Mathematics I	4	2			6	4	20	80	3				100	
4	EG1104SH	Engineering Physics I	4	2		2	8	5	20	60	3	10	10	2	100	
5	EG1105SH	Engineering Chemistry I	4	2		2	8	5	20	60	3	10	10	2	100	
6	EG1101AR	Engineering Drawing I	1		4		5	3	0	0		60	40	4	100	
7	EG1101CT	Computer Application	2		2		4	3	10	40	1.5	30	20	3	100	
		Total	**23**	**6**	**6**	**4**	**39**	**28**							**700**	

Year: I **Part: II**

S.N.	Code No.	Subject	Teaching Scheme						Examination Scheme						Total Marks	Remarks
			Mode				Weekly Hours	Credit Hours	DISTRIBUTION OF MARKS							
									Theory			Practical				
			L	T	P	Lab			*Assmt. Marks	Final		*Assmt. Marks	Final			
										Marks	Time (Hrs.)		Marks	Time (Hrs.)		
1	EG1201SH	Engineering Mathematics II	4	2			6	4	20	80	3				100	*Continuous assessment
2	EG1202SH	Engineering Physics II	4	2		2	8	5	20	60	3	10	10	2	100	
3	EG1203SH	Engineering Chemistry II	4	2		2	8	5	20	60	3	10	10	2	100	
4	EG1201CE	Workshop Practice I	2		6		**8**	5	0	0		60	40	4	100	
5	EG1201AR	Engineering Drawing II	0		4		4	2	0	0		60	40	4	100	
6	EG1202CE	Applied Mechanics	3	2		2/2	6	4	20	60	3	20	0		100	
		Total	**17**	**8**	**10**	**5**	**40**	**25**							**600**	

Diploma in Electrical and Electronics Engineering

Year: II **Part: I**

S.N.	Code No.	Subject	Teaching Scheme						Examination Scheme						Total Marks	Remarks
			Mode				Weekly Hours	Credit Hours	DISTRIBUTION OF MARKS							
									Theory			Practical				
			L	T	P	Lab			*Assmt. Marks	Final		*Assmt. Marks	Final			
										Marks	Time (Hrs.)		Marks	Time (Hrs.)		
1	EG2101EE	Fundamentals of Electrical Engineering	3	1		2	6	4	20	80		30	20	3	150	*Continuous assessment
2	EG2102EE	Computer Programming	2		2		4	3	10	40	1.5	30	20	3	100	
3	EG2101EEX	Basic Electronics	3	1		2	6	4	20	80	3	30	20	3	150	
4	EG2105EE	Electrical Engineering Material	4				4	4	20	80	3				100	
5	EG2107EE	Electrical Installation I	1		4		5	3				60	40	4	100	
6	EG2102EEX	Electrical and Electronics Engineering Drawing			4		4	2				60	40	4	100	
7	EG2103EEX	Computer Aided Drawing	2		2		4	3	10	40	1.5	30	20	3	100	
8	EG2104EEX	Digital logic	3	1		3	7	5	20	80		30	20	3	150	
		Total	**18**	**3**	**12**	**7**	**40**	**28**							**950**	

Year: II **Part: II**

S.N.	Code No.	Subject	Teaching Scheme						Examination Scheme						Total Marks	Remarks
			Mode				Weekly Hours	Credit Hours	DISTRIBUTION OF MARKS							
									Theory			Practical				
			L	T	P	Lab			*Assmt. Marks	Final		*Assmt. Marks	Final			
										Marks	Time (Hrs.)		Marks	Time (Hrs.)		
1	EG2201EE	Microprocessors	3	1	2		6	5	20	80	3	30	20	3	150	
2	EG2203EE	Electric Circuit Analysis	3	1		2	6	4	20	80	3	30	20	3	150	*Continuous assessment
3	EG2201EEX	Electronics Devices and Circuits	3	1		2	6	4	20	80	3	30	20	3	150	
4	EG2202EEX	Basic Programmable Logic Control (PLC)	3	1		2	6	4	20	80	3	30	20	3	150	
5	EG2206EE	Electrical Machines I	3	1		2	6	4	20	80	3	30	20	3	150	
6	EG2207EE	Electrical Instruments and Measurements	3	1		2	6	4	20	80	3	30	20	3	150	
7	EG2203EEX	Repair and Maintenance of Consumer Appliances I	1		3		4	2				60	40	4	100	
		Total	**19**	**6**	**5**	**10**	**40**	**27**							**1000**	

Diploma in Electrical and Electronics Engineering

Year: III **Part: I**

S.N.	Code No.	Subject	Teaching Scheme						Examination Scheme						Total Marks	Remarks
			Mode				Weekly Hours	Credit Hours	DISTRIBUTION OF MARKS							
									Theory			Practical				
			L	T	P	Lab			*Assmt. Marks	Final		*Assmt. Marks	Final			
										Marks	Time (Hrs.)		Marks	Time (Hrs.)		
1	EG3101EE	Switch Gear and Protection	4			2	6	5	20	80	3	30	20	3	150	*Continuous assessment
2	EG3102EE	Power Electronics	3			2	5	4	20	80	3	30	20	3	100	
3	EG3103EE	Electrical Machines II	3	1		3	7	5	20	80	3	30	20	3	150	
4	EG3101EEX	Minor Project			4		4	2				60	40	4	100	
5	EG3102EEX	Digital Electronics Circuit	3	1		3	7	5	20	80	3	30	20	3	150	
6	EG3103EEX	Repair and Maintenance of Consumer Appliances II	1		3		4	3				30	20	3	100	
7	EG3104EEX	Communication System I	4		2		6	5	20	80	3	30	20	3	150	
		Total	**18**	**2**	**9**	**10**	**39**	**29**							**900**	

Year: III **Part: II**

S.N.	Code No.	Subject	Teaching Scheme						Examination Scheme						Total Marks	Remarks
			Mode				Weekly Hours	Credit Hours	DISTRIBUTION OF MARKS							
									Theory			Practical				
			L	T	P	Lab			*Assmt. Marks	Final		*Assmt. Marks	Final			
										Marks	Time (Hrs.)		Marks	Time (Hrs.)		
1	EG3201EEX	Communication System II	4		2/2		5	5	20	80	3				100	*Continuous assessment
2	EG3202EEX	Design, Estimating & Costing of Electrical & Electronics Installation	3		2		5	4	20	80	3	30	20	3	100	
3	EG3203EEX	Major Project			6		6	3				90	60	6	150	
4	EG3204EEX	Industrial Attachment			4		4	2				60	40	4	100	
5	EG3201MG	Entrepreneurship Development	3		2		5	4	20	60	3	10	10	2	100	
6	EG3205EEX	Basic Computer Network	3	1	2		6	4	20	80	3	30	20	3	150	
7	EG3206EE	Transmission and Distribution of Electrical Power	3	1			4	3	20	80	3				100	
8		Elective	4		2/2		5	5	20	80	3				100	
	EG3206EEX.1	a) Hydro Power														
	EG3206EEX.2	b) Broadcast Engineering														
	EG3206EEX.3	c) Renewable Energy Technology														
	EG3206EEX.4	d) Electrical Energy Management														
	EG3206EEX.5	e) Internet/Intranet														
	EG3206EEX.6	f) Satellite Communication														
		Total	**20**	**2**	**18**		**40**	**30**							**900**	

First Year (First and Second Semesters)

[See Separate Curriculum]
([Year I Part I and Year I Part II) Engineering All

Second Year/ First Part

S.N.	Course Code	Subject
1	EG2101EE	Fundamentals of Electrical Engineering
2	EG2102EE	Computer Programming
3	EG2101EEX	Basic Electronics
4	EG2105EE	Electrical Engineering Material
5	EG2107EE	Electrical Installation I
6	EG2102EEX	Electrical and Electronics Engineering Drawing
7	EG2103EEX	Computer Aided Drawing
8	EG2104EEX	Digital logic

Fundamental of Electrical Engineering

EG2101EE

Year: II **Total: 6 hours /week**

Part: I **Lecture: 3 hours/week**

Tutorial: 1 hour/week

Practical: hours/week

Lab: 2 hours/week

Course Description:

This course provides a basic framework for understanding the fundamental concept of electric circuits. The course deals with circuit fundamentals and electrostatics and electromagnetic phenomena.

Course Objectives:

After completing this course, the students will be able to:

1. Explain the concept of electric circuits.
2. State the principles of electricity, magnetism.
3. Describe the electromagnetic phenomena and its applications.

Course Contents:

Theory

Unit 1. Basic Concept of Electricity **[7 Hrs.]**

1.1. Electric charge and current
1.2. Conventional versus electron flow
1.3. Potential difference and electromotive force
1.4. Conductors, insulators and electron flow
1.5. Resistance and its variation with temperature and related numerical
1.6. Direct and alternating current

Unit 2. Electric Circuit Fundamentals **[10 Hrs.]**

2.1. Circuit elements: Resistor, Inductor, Capacitor
2.2. Electric current and voltage: definition and explanation.
2.3. Independent and dependent sources
2.4. Series and parallel circuits
2.5. Ohm’s law: definition, explanation and limitations.
2.6. Kirchoff's law: explanation and application.
2.7. Electric power and energy
2.8. Numerical problems

Unit 3. Electrostatics **[8 Hrs.]**

3.1. Laws of electric forces
3.2. Electric field and electric field intensity
3.3. Electric fluxes and flux density
3.4. Dielectrics, permittivity and relative permittivity
3.5. Electrostatic induction phenomena
3.6. Electric potential, potential difference and potential gradient
3.7. Capacitors and capacitance

3.8. Series and parallel connection of capacitors and related numerical problems
3.9. Factors affecting capacitance
3.10. Energy stored in charged capacitor
3.11. Charging and discharging of capacitor, time constant for charging/discharging

Unit 4. Magnetism and Electromagnetism [8 Hrs.]

4.1. Definition of magnetic field, magnetic flux, flux density, filed intensity and permeability of magnetic material, domain theory of magnetism
4.2. Permanent magnets and electro-magnets
4.3. Permeability and relative permeability of magnetic material
4.4. Dia-magnetic, para-magnetic and ferro-magnetic materials
4.5. Magnetic field due to current carrying conductor, force on a current carrying conductor
4.6. Hysteresis loop for magnetic material, hard and soft magnetic material

Unit 5. Electro Magnetic Induction [6 Hrs.]

5.1. Faraday's laws of electromagnetic induction, direction of induced emf& current.
5.2. Relation between electricity and magnetism, production of induced emf& current
5.3. Lenz's law, dynamically induced emf, statistically induced emf.
5.4. Self-inductance, coefficient of self-inductance (L), Mutual inductance, coefficient of mutual inductance (M), coefficient of coupling and related numerical problems.
5.5. Energy stored in a current carrying inductor and related numerical problems.
5.6. Inductance in series, inductance in parallel and related numerical problems.
5.7. Magnetic circuit concept, analogy to electric circuit

Unit 6. Electrolysis and its Application [6 Hrs.]

6.1. Faraday’s law of electrolysis and its applications
6.2. Primary and secondary cells: definitions and examples, internal resistance of cell
6.3. Lead acid cell: construction, chemical reaction during charging and discharging, methods of charging (constant voltage and constant current charging)
6.4. Dry cell, Mercury cell, Ni-Cd cell, Li-ion cell
6.5. Series and parallel connection of batteries

Practical: [30 Hrs.]

1. Use Ammeter and Voltmeter to measure current and voltage. Identify and scale and range settings of such meters.
2. Verify Ohm’s law.
3. Verify Kirchhoff’s current and voltage laws.
4. Measure resistance and resistivity of wire.
5. Conduct B-H Curve for hard and soft magnetic materials.
6. Perform the application of electromagnets.
7. Measure internal resistance of batteries.
8. Charge and discharge lead acid battery.

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***

1	Basic Concept of Electricity	7	12
2	Electric Circuit Fundamentals	10	18
3	Electrostatics	8	14
4	Magnetism and Electromagnetism	8	14
5	Electro Magnetic Induction	6	11
6	Electrolysis and its Application	6	11
	Total	**45**	**80**

* There may be minor deviation in marks distribution.

References:

1. Theraja, B.L. & Theraja, A.K., (2021), A Textbook of Electrical Technology.
2. Gupta, J.B., (2010), Fundamentals of Electrical Engineering
3. Del Toro, Vincent, (2015), Electrical Engineering Fundamentals
4. Cogdell, John R. (1990), Foundations of Electrical Engineering

Computer Programming
EG2102EE

Year: II **Total: 4 hours /week**
Part: I **Lecture: 2 hours/week**
Tutorial: hours/week
Practical: hours/week
Lab: 2 hours/week

Course Description:
This course deals with the problem-solving techniques using C programming language. It provides the students with the knowledge of the basic features of the C language such as data types, keywords, operators, control structure, array, function, Pointer and data files.

Course Objectives:
After completion of this course students will be able to:
1. Implement fundamentals concepts of programming language.
2. Apply sequential, conditional and looping statements while developing programs.
3. Create programs using array.
4. Make and apply programs using function, pointer and data files.

Course Contents:

Theory

Unit 1. Programming Language Fundamentals [4 Hrs.]
- 1.1. Introduction to Program and Programming Language
- 1.2. Types of Programming Language (Low Level and High-Level Language)
- 1.3. Language Translator (Assembler, Compiler and Interpreter)
- 1.4. Program Design Tools (Algorithm, Flowchart)

Unit 2. Introduction to C [6 Hrs.]
- 2.1. Overview and History of C
- 2.2. Features, Advantages and Disadvantages of C
- 2.3. Structure of C Program, Compiling Process
- 2.4. Data types, Keywords, Variables, Identifiers
- 2.5. Preprocessor Directives, Escape Sequence, Comments

Unit 3. Operators [2 Hrs.]
- 3.1. Operators, Operand, Operation
- 3.2. Types of Operators (Unary, Binary, Ternary, Arithmetic, Relational, Logical, Assignment, Increment/Decrement, Conditional)

Unit 4. Control Structure/Statement [8 Hrs.]
- 4.1. Sequential Statement
- 4.2. Conditional Statement
  - 4.2.1. if statement
  - 4.2.2. if…else statement
  - 4.2.3. if…else if…else statement
  - 4.2.4. Switch statement
- 4.3. Loop (for, while and do-while)

Unit 5. Array **[4 Hrs.]**

5.1. Introduction to Array
5.2. Types of Arrays
  5.2.1. 1-D Array (Declaration, Initialization)
  5.2.2. Multi-Dimensional Array: 2-D Array (Declaration, Initialization)

Unit 6. Function **[3 Hrs.]**

6.1. Introduction to Function
6.2. Function components (function declaration, function call, function definition)
6.3. Types of function (library/built-in function and user-defined function)

Unit 7. Pointer and Data files **[3 Hrs.]**

7.1. Introduction to Pointer
7.2. Introduction to data files
7.3. File handling operation
7.4. Library functions for READING from a file and WRITING to a file: (fputs, fgets and fprintf)

Practical: **[30 Hrs.]**

1. Implement program using sequential statement.
2. Implement program using conditional statements.
3. Implement program using for, while and do-while loop.
4. Implement program using 1-D and 2-D array.
5. Implement program using function.
6. Implement program using pointer.
7. Implement program for reading from a file and writing to a file using fputs, fgets and fprintf function.

Final written exam evaluation scheme			
Unit	**Title**	**Hrs.**	**Marks Distribution***
1	Programming Language Fundamentals	4	5
2	Introduction to C	6	8
3	Operators	2	3
4	Control Structure/Statement	8	11
5	Array	4	5
6	Function	3	4
7	Pointer and Data files	3	4
	Total	**30**	**40**

* There may be minor deviation in marks distribution.

References:

- Gotterfried, B. (2001). Programming with C. (3rd ed.). India: Mcgraw Hill Education.
- Thareja, R. (2015). Introduction to C Programming. (2nd ed.). India: Oxford University Press.

- Balagurusamy, E. (2008). Programming in ANSI C. (6th ed.). India: The McGraw Hill Companies.

Basic Electronics
EG2101EEX

Year: II **Total: 6 hours /week**
Part: I **Lecture: 3 hours/week**
Tutorial: hour/week
Practical: 3 hours/week
Lab: hours/week

Course Description:
This course will provide skill and knowledge to Basic Electronics Engineering. The students will learn and practice on PN Junction diode, BJT and FET and other electronic devices.

Course Objectives:
On completion of this course the students will be able to:
1. Introduce electronics in different fields as application
2. Explain formation of P-N junction.
3. Apply diodes as rectifier and regulators.
4. Apply BJT as amplifier, switch.
5. Apply FET as amplifier and other application.
6. Explain different special electronic devices and its applications

Course Contents:

Theory

Unit 1. Introduction [4 Hrs.]

1.1. Introduction and use of electronics engineering in different fields.
1.2. Independent and dependent voltage and current sources. Voltage and Current Sources, its types and examples
1.3. Passive and active components, DC and AC quantities, and methods of analysis.
1.4. Intrinsic and extrinsic semiconductors (Si & Ge) and their electrical properties; valence, conductance and forbidden band
1.5. Doping, majority and minority charge carriers; free and bound charges; depletion layer and barrier potential.

Unit 2. PN Junction Diode [10 Hrs.]

2.1. Construction of PN Junction diode. Formation of P-N junction Diode.
2.2. Forward and reverse biasing; IV-Characteristics and working formula; DC and AC resistances of diode in circuits; temperature effects upon PN Junction. $i_D = I_s (e^{V_D/nV_T} - 1)$
2.3. DC biasing of diode circuits: Graphical analysis using IV-Characteristic graph and load line, and, algebraic analysis.
2.4. Reverse breakdown phenomena and Zener diode: Zener and avalanche effects.
2.5. Rectifier circuits
    2.5.1. Half wave and full wave rectifier circuits. Peak value, RMS value and Average value.

2.5.2. Voltage doubler and tripler circuits.

2.6. Construction of dc voltage power supply from ac power source: dc voltage output, ripple voltage, PIV.

2.7. Regulated dc voltage power supply using Zener diode with calculation.

Unit 3. Bipolar Junction Transistor [15 Hrs.]

3.1. Construction and working principles of BJT; base-emitter junction; base-collector junction. Majority and minority charge carriers, depletion layer and barrier potential I_B, I_E and I_C currents, their inter-relationship using α and β terms.

3.2. Configurations of BJT amplifiers: CB, CE and CC amplifiers, I-V characteristics and their properties.

3.3. DC or static input-output IV characteristics

3.3.1. CB amplifier configuration

3.3.2. CE amplifier configuration

3.3.3. CC amplifier configuration

3.3.4. 3.3Active, saturation, cut off and breakdown regions of operations.

3.3.5. Leakage current and temperature effect

3.4. DC biasing for CE amplifier circuit

3.4.1. Graphical and algebraic analyses to determine the dc operating Q- points.

3.4.2. Circuit analysis of fixed biasing, emitter feedback biasing, collector feedback biasing and voltage divider type DC biasing with simple numerical.

3.4.3. Coupling of amplifiers: RC, transformer and direct couplings and their features.

3.4.4. BJT as switch and BJT to drive Relay: BJT as signal amplifier.

Unit 4. Field Effect Transistor (FET) [8 Hrs.]

4.1. Construction and working principle of JFET. IV-Characteristics and working formula, and different regions of operations.

4.2. Construction and working principle of MOSFET. IV-Characteristics and working formula, and different regions of operations.

4.3. DC biasing for C.S. (common source) MOSFET amplifier circuit:

4.3.1. Graphical and algebraic methods of analysis to determine dc operating points.

4.4. Self-biasing of FET amplifier circuit

4.5. FET as switch; NOT gate operation.

Unit 5. Special Semiconductor Devices [8 Hrs.]

5.1. Varactor Diode, Photodiode, LED, Solar Cell, Schottky Diode and its applications

5.2. Opto-coupler, Hall Effect construction, characteristics and basic applications.

Practical: [30 Hrs.]

Lab 1. Demonstrate by teacher and practice by students to learn the knowledge of the following:

1.1. Colour code reading of resister and capacitors.
1.2. Analog and Digital AVO meter.
1.3. Analog and Digital Oscilloscopes
1.4. Function Generators.
1.5. DC voltage power supplies used in laboratory.

Lab 2. Construct and analyze PN -Junction diode circuit for in forward and reverse biased circuit.

Lab 3. Construct and analyze Zener diode in forward and reverse biased circuit.

Lab 4. Construct and analyze different rectifier circuits and unregulated dc power supply circuit.

Lab 5. Construct BJT as signal amplifier and find gain, as a switch and switch a led and as relay driver to drive a relay

Lab 6. Construct and analyze FET circuit for dc output IV- characteristics.

Lab 7. Design and construct simple LED circuit, Photo Diode circuit.

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	Introduction	4	7
2	PN Junction Diode	10	18
3	Bipolar Junction Transistor (BJT)	15	27
4	Field Effect Transistor (FET)	8	14
5	Special Semiconductor Devices	8	14
	Total	**45**	**80**

* There could be minor deviation in mark distribution.

References:

1. Gupta J.B. (2013). An Integrated course in Electronics Engineering.SK Kataria
2. Bell A. David (2008) Electronic Devices and Circuits. OXFORD UNIVERSITY PRESS
3. David A. Bell (2009) Laboratory Manual for Electronic Devices and circuits. OXFORD UNIVERSITY PRESS
4. Theodore F. Bogart (2019) Electronic Devices and Circuits. Pearson
5. Robert Boylestad, Luis Nashelsky (2009) Electronic Devices and Circuits. Pearson India

Electrical Engineering Material

EG1205EE

Year: II **Total: 4 hours /week**

Part: I **Lecture: 4 hours/week**

Tutorial: hour/week

Practical: hours/week

Lab: hours/week

Course Description:

This course deals with the properties of Magnetic, Resistor, and Dielectric and Semiconductor materials from the peripherals of electrical engine.

Course Objectives:

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

1. Identify and use magnetic materials used in electrical system.
2. Explain the working process of semiconductor material.
3. Define dielectric, Dielectric, Resistor alloys.

Course Contents:

Theory

Unit 1. Conducting Material [10 Hrs.]

1.1. Commonly used resistors, alloys of Nickel, Iron, Chromium, Aluminum.
1.2. Band structure of conductors, energy gap
1.3. Electrical properties: resistivity, conductivity, effect of temperature, concept of drift and mobility
1.4. Resistor alloys:
  1.4.1. Alloys of Ni, Fe, Cr, Al
  1.4.2. Mechanical characteristics
  1.4.3. Industrial application

Unit 2. Magnetic material [20 Hrs.]

2.1. Classification based on ferrous material and non-ferrous material
2.2. Characteristics and their use
2.3. B-H characteristics
2.4. Hysteresis loop, eddy current losses
2.5. Magnetic permeability and susceptibility
2.6. Domain structure
2.7. Ferrous materials
  2.7.1. Common ferrous materials and their engineering characteristics
  2.7.2. Industrial applications
  2.7.3. Corrosion: cause, effect and methods of prevention
2.8. Non-ferrous materials
  2.8.1. Common non-ferrous materials and engineering characteristics
  2.8.2. Some non-ferrous alloy (copper, aluminum, brass, bronze, silver, gold) and their Industrial application
  2.8.3. Carbon as an electrical material, its product (brushes) and application

2.8.4. Chemical/corrosion characteristics of some commonly used non-ferrous metals

Unit 3. Dielectric materials [18 Hrs.]

3.1. Definition of dielectric, macroscopic approach, Dielectric constant, Electric Dipole moment
3.2. Polarization mechanism: electronic polarization, orientation(dipolar) polarization, interfacial polarization and total polarization
3.3. Dielectric losses, frequency and temperature effects
  3.3.1. Dielectric breakdown in gases
  3.3.2. Dielectric breakdown in liquids
  3.3.3. Dielectric breakdown in solids
3.4. Ferro electricity and Piezo-electricity
3.5. Properties of some dielectric materials
3.6. Insulating materials
3.7. Identification of insulating materials in general uses and their characteristics
3.8. Electrical characteristics of some insulating materials e.g. plastics, resign, porcelain, glass, fiber glass, mica, oil, insulating varnishes, gases (SF6)

Unit 4. Semiconductor materials [12 Hrs.]

4.1. Definition, elements of semi-conductor materials, electrical nature.
4.2. Band structure of Group IV materials, energy gap.
4.3. Atomic structure, electronic properties of silicon, germanium
4.4. Formation of electron and hole
4.5. Electrical conduction in semi-conductors
4.6. Intrinsic and Extrinsic semiconductor, concept of doping
4.7. N type semiconductor
4.8. P type semiconductor
4.9. Fermi level, contact potential and see back effect
4.10. Metal semic-conductor junction: Schottky Junction and Ohmic contact

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	Conducting Material	10	14
2	Magnetic material	20	26
3	Dielectric materials	18	24
4	Semiconductor materials	12	16
	Total	**60**	**80**

* There could be minor deviation in mark distribution.

References:

1. Banerjee, G.K. (2014). *Electrical and Electronic Engineering Materials (14th Ed.)*. PHI Learning.
2. Pokharel, B.P. & Karki, N.R.(2007). *Electrical Engineering Materials (1st Ed.).* Oxford: Alpha Science.

3. Mithal, G.K. (1991). *Electrical Engineering Materials (2nd Ed.).* Delhi-6: Khanna Publications.
4. Gupta, J.B. (2013). *Electrical and Electronic Engineering Materials.* S K Kataria and Sons.

Electrical Installation I

EG2107EE

Year: II **Total: 5 hours /week**
Part: I **Lecture: 1 hours/week**
Tutorial: hour/week
Practical: 4 hours/week
Lab: hours/week

Course Description:
The course deals with PVC and metal conduit wiring supply intake to load points, earth system, concealed wiring in new buildings and single phase and three phase motor starters.

Course Objectives:
On studying and performing of this course, students will be able to:

1. Identify wiring systems, wiring accessories, protection devices and safety precautions.
2. Select and install accessories and fittings for single phase and three phase wiring systems.
3. Draw and follow electrical layout and diagrams.
4. Schedule the quantities of materials and cost estimate.
5. Test wiring and earth system.
6. Follow the wiring rules and code of practices.

Course Contents:

Theory

Unit 1. Introduction, descriptions, safety precautions, importance and application [15 Hrs.]

1.1. Wiring rules, regulations and code of practices
1.2. Electrical hazards (fire and shock) and safety precautions
1.3. Electric shock and shock effects. Rescue and basic treatment to shock victim
1.4. Types of wiring system and accessories required for PVC and metal conduit wiring
1.5. Types of light and power fixtures. Selection of wiring cables for light and power, Current carrying capacity of PVC insulated copper cables
1.6. Use and selection of protective devices such as Fuse, MCB, MCCB, ELCB, Thermal bimetal relays etc.
1.7. Use and care of measuring instruments such as Ammeter, Voltmeter, Ohmmeter, etc.
1.8. Types of diagram use for electrical installations or wirings
1.9. Rotating direction changing methods of single phase, three phase and universal motors
1.10. Continuity test, insulation test, short circuit test, open circuit test, polarity test and earth fault test of wiring systems
1.11. Earthing and its importance, materials required for earthing, required parts to be earthed, procedure of earth testing and methods of earth resistance corrections

Practical: [60 Hrs.]

Unit 1. Wiring projects on cubical in conduit wiring [45 Hrs.]

1.1. Install 8-way DB with 32 Amps DP MCB, 6- and 16-Amps SP MCBs for light and power circuit as per given dimensions and instructions.
1.2. Install and connect circuits to control lamps from one, two and three stations by one way, two way and intermediate switches as per given layout diagram.
1.3. Install and connect lamps in series and parallel to verify the lighting conditions. Also connect 2 pin socket and indicator as per given layout diagram.
1.4. Install and connect the circuits for ceiling fan and FTL. Also connect a 3-pin power socket in a power circuit branch as per given layout diagram.
1.5. Install and connect a bell circuit to bell from one station and another bell to bell from two or more stations. Also connect power sockets in parallel in two stations as per given layout diagram.
1.6. Install and connect a circuit for single phase capacitor start and run induction motor to control by a DP switch. Then replace the DP switch by a F/R switch to run the motor in CW and CCW direction.
1.7. Install and connect the circuit for traffic lights suitable for four-way road junction with timers or time switches as per given layout diagram.
1.8. Install and connect a circuit to run a 3-phase star connected induction motor by an on/off drum type rotary switch with TPMCB for short circuit protection and 3 phase indicating lamps.
1.9. Install and connect a circuit for a star connected 3 phase induction motor to rotate in CW and CCW direction by a F/R drum type rotary switch with TPMCB and 3 phase indicating lamps.
1.10. Install and connect a circuit to start a 3-phase induction motor in star mode and run in delta mode by a star/delta drum type rotary switch TPMCB, thermal OLR and 3 phase indicating lamps.

Unit 2. Earthing [8 Hrs.]

2.1. Install an earth electrode (copper plate) with complete requirements as per given diagram and instructions.
2.2. Test the performance of earth resistance by an earth tester and correct it if necessary.

Unit 3. Field visit [7 Hrs.]

3.1. Visit PVC pipe laying for concealed wiring of a new building. Observe the pipe laying and distribution system from DB to junction boxes, switch points, light points, power points, prepare lay out diagram and material list for presentation.

References:

1. Electrical wiring Fundamentals, Foley
2. Electrical Installation and Workshop Practice, FG Thompson
3. Electrical Installation Estimating and Costing, JB Gupta
4. Manufacturer's catalogue for motor starters, MCB, MCCB, ELCB etc.

Electrical & Electronics Engineering Drawing

EG2102EEX

Year: II **Total: 4 hours /week**

Part: I **Lecture: hours/week**

Tutorial: hour/week

Practical: 4 hours/week

Lab: hours/week

Course Description:

This course deals with ISO standard symbols of electrical/electronic and digital components, simple electrical and electronics circuits and block diagram of some domestic consumable electronics equipment as well as with lighting, D.C. motor, D.C. generator connection and control diagrams.

Course Objectives:

On completion of this course the students will able to:

1. Describe and use electrical and electronic symbols.
2. Draw basic electrical/electronic symbols (standard / freehand).
3. Draw free hand sketches of components, equipment and electrical/electronic circuits.
4. Interpret the circuit diagrams and block diagrams.
5. Prepare the layout and wiring diagrams for buildings and equipment.
6. Prepare schematic diagrams from wiring diagrams and
7. Draw sectional view of the given three dimensional solid

Course Contents:

Practical:

Sheet 1. Draw symbols of fuses, relays, switches, circuit-breakers, motors, generators, transformers, earthing, lamps, tube lights etc. **[2 Hrs.]**

Sheet 2. Draw symbols of: **[2 Hrs.]**

- 2.1. Passive components such as different types of resistors, different types of capacitors, Inductors.
- 2.2. active components as semiconductor devices (diodes: PN junction diode, Zener diode, LED; transistors PNP/NPN,

Sheet 3. Sheet No. 3 Draw symbols of: **[2 Hrs.]**

- 3.1. Special semiconductor devices such as JFET, MOSFET, CMOS, Thyristors
- 3.2. Digital electronic devices such as gates AND, OR,NOT, NAND, NOR, XOR, XNOR, Flip-Flops

Sheet 4. Draw simple, two way and intermediate switches connection for building lighting and impulse relay and timer for street lighting. **[2 Hrs.]**

Sheet 5. Draw circuit diagram of simple measuring instruments **[4 Hrs.]**

- 5.1. Multi-range voltmeter
- 5.2. Multi-range ammeter
- 5.3. Multi-range ohmmeter
- 5.4. Conversion of galvanometer to
  - 5.4.1. Voltmeter
  - 5.4.2. Ammeter

Sheet 6. Draw connection diagram of DC generator and its control circuit **[4 Hrs.]**

6.1. Separately excited

6.2. Series

6.3. Shunt

6.4. Compound wound

Sheet 7. Draw connection diagram of DC motor and its control circuit **[4 Hrs.]**

7.1. Series

7.2. Shunt

7.3. Compound wound

Sheet 8. Draw connection and diagram of capacitor start, capacitor run and capacitor start and Run single phase motor. **[4 Hrs.]**

Sheet 9. Draw detail panel board fabrication diagram of 250 Amp incoming MCCB. **[4 Hrs.]**

1. 3×100 Amp outgoing MCCB –
2. 2×60 Amp outgoing MCCB –
3. 2×40 Amp outgoing MCCB –
4. 2×20 Amp outgoing MCCB –
5. 1×20 Amp Black space
6. 300 Amp TPN Busbar, earth busbar, Voltmeter, Ammeter CTS – selector switches, Indicator, all complete.

Sheet 10. Draw connection diagrams for 3-phase, 5 hp 380v delta connected squirrel age induction motor controlled by a star/delta rotary switch and fuses. **[4 Hrs.]**

Sheet 11. Draw connection and control diagram for 3–phase, 5hp 380V squirrel cage induction motor controlled with the Dol starting and automatic reversing using contactors and limit switches. **[4 Hrs.]**

Sheet 12. Draw connection and control diagram for 3–phase, 10hp 380V delta connected squirrel cage induction motor with automatic star/delta starting, overload trips, a limit switch and electromagnetic brake. **[4 Hrs.]**

Sheet 13. Draw wiring and connection diagram of substation with incoming and outgoing 11KV OCBS, its control and differential protection. **[4 Hrs.]**

Sheet 14. **[2 Hrs.]**

14.1. Draw block diagram of basic computer.

14.2. Draw block diagram of basic full adder circuit, basic subtractor circuit using logic gates.

14.3. Draw operational amplifier integrator, differentiator using OPAM.

Sheet 15. Draw detail installation diagrams of plate electrode earthing system with watering provision **[4 Hrs.]**

Sheet 16. Draw connection diagram of 220V/ 6V.AC to DC conversion adapter with half Wave and full wave rectification providing necessary filter **[2 Hrs.]**

Sheet 17. Draw sectional views of a 3-phase transformer **[8 Hrs.]**

17.1. Use of sectional views
17.2. Cutting plane line and hatching lines
17.3. Types of Section: Full section and Half Section
17.4. Exercises on Full Section of Transformer

References:

1. Lister, E.C. (2020), Electrical circuit and machines, McGraw-Hill
2. Roe, L.B. (1972). Practices and Procedure of Industrial Electrical Design. McGraw-Hill.
3. Say, M.G., Electrical engineering design manual, Chapman and Hall
4. Singh Surjit (2020),''Electrical Engineering drawing,'' S.K. Katariya & Sons, India
5. Gupta, J.B. (2021), A course in Electrical Installation Estimating & Costing (9th ed.). S.K. Kataria & Sons.
6. Charles J. Baer, Electrical and Electronics Drawing, McGraw-Hill Companies; 4th edition
7. A K Mittal, Computech Publications Limited (Asian Publishers); ELECTRONICS ENGINEERING DRAWING, 5TH edition (1 January 2021)

Computer Aided Drawing

EG2103EEX

Year: II **Total: 4 hours /week**

Part: I **Lecture: 2 hours/week**

Tutorial: hour/week

Practical: 2 hours/week

Lab: hours/week

Course Description:

This course deals with creation of two-dimensional drawing and layout drawing using Auto CAD. It also deals with application of AutoCAD software in electrical field.

Course Objectives:

After completing this course, the students will be able to

1. Introduce AutoCAD software and its basic commands.
2. Draw 2D drawings and modify them.
3. Insert dimension and text on drawing.
4. Use AutoCAD in electrical sector.

Course Contents:

Theory

Unit 1. AutoCAD [3 Hrs.]

1.1. Introduction
1.2. Application
1.3. Application of Basic Tools
  1.3.1. Keyboard,
  1.3.2. Cursor menu,
  1.3.3. Screen menu,
  1.3.4. Pull-down menu,
  1.3.5. Toolbar menu
  1.3.6. Dialogue box

Unit 2. Basic Commands and Drawing Aids [7 Hrs.]

2.1. Drawing Commands (LINE, POINT, XLINE, ARC, CIRCLE, Polygon, PLINE, MLINE, SPLINE)
2.2. Modifying Commands (ERASE, OFFSET, COPY, MOVE, CHPROP, ROTATE, MIRROR, ARRAY, FILLET, TRIM, LTTYPE, LTSCALE, DIVIDE)
2.3. Drawing Aids (ORTHO, GRID, SNAP, OSNAP)
2.4. Display Commands (ZOOM, PAN VIEW)
2.5. HATCH and BHATCH commands
2.6. Creation of Layer and Working on it.
2.7. Layer Properties

Unit 3. Grouping in AutoCAD [3 Hrs.]

3.1. BLOCK, WBLOCK commands
3.2. INSERT, MINSERT commands
3.3. EXPLODE, BASE commands

Unit 4. Working with text in AutoCAD **[2 Hrs.]**

4.1. TEXT, MTEXT, DTEXT commands
4.2. Justifying text and text fonts
4.3. STYLE command

Unit 5. Dimensioning in AutoCAD **[2 Hrs.]**

5.1. Dimensioning commands
5.2. Dimension styles and dimension setup
5.3. Dimension scale

Unit 6. AutoCAD in Electrical Field **[4 Hrs.]**

6.1. Necessity of AutoCAD in Electrical Engineering
6.2. Current scenario of AutoCAD for Electrical Engineering
6.3. Use of AutoCAD in Building Electrification

Unit 7. Layout and Plotting Drawing **[5 Hrs.]**

7.1. Use of AutoCAD Design center
7.2. Layout drawing using standard symbols
7.3. Layout management
7.4. Using Layout to set up a print
7.5. Device information, pen parameters, paper size and orientation
7.6. Scale, rotation and origin
7.7. Printing a drawing

Unit 8. Computer Aided PCB Design **[4 Hrs.]**

8.1. Overview of software for PCB design
8.2. PCB layout of rectifier circuit
8.3. PCB layout of amplifier circuit
8.4. PCB layout of oscillator circuit

Practical: **[30 Hrs.]**

Lab 1. Install and initiate AutoCAD.
Lab 2. Apply different commands present in AutoCAD:
2.1. Drawing Commands (LINE, POINT, XLINE, ARC, CIRCLE, Polygon, PLINE, MLINE, SPLINE etc.)
2.2. Modifying Commands (ERASE, OFFSET, COPY, MOVE, CHPROP, ROTATE, MIRROR, ARRAY, FILLET, TRIM, LTTYPE, LTSCALE, DIVIDE etc)
2.3. Drawing Aids (ORTHO, GRID, SNAP, OSNAP etc), display commands (ZOOM, PAN VIEW etc) and HATCH and BHATCH commands.
Lab 3. Draw figures in AutoCAD.
Lab 4. Use/Insert command in AutoCAD:
4.1. ERASE, OFFSET, COPY, MOVE, CHPROP, ROTATE, MIRROR, ARRAY, FILLET, TRIM, LTTYPE, LTSCALE, DIVIDE.
Lab 5. Apply Auto CAD [*Week 6 to 11*]
5.1. Draw simple electrification of a single floor with single line diagram,

5.2. Draw industrial wiring system coordinating with control panel with respective power and control diagram.

Lab 6. Layout Drawing.

Lab 7. Plot and print drawing.

Lab 8. Draw electrical and electronic symbols using AutoCAD and take print out.

Lab 9. Draw R-C couple amplifier circuit using Auto CAD and take print out.

List of Software

1. Open-Source Software preferred.
2. AutoCAD
3. Work bench
4. PSIM
5. SPICE (Simulation Program with Integrated Circuit Emphasis)
6. Orcad for PCB design
7. Circuit maker
8. Multi-Sim

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	AutoCAD	3	4
2	Basic Commands and Drawing Aids	7	9
3	Grouping in AutoCAD	3	4
4	Working with text in AutoCAD	2	3
5	Dimensioning in AutoCAD	2	3
6	AutoCAD in Electrical Field	4	5
7	Layout and Plotting Drawing	5	7
8	Computer Aided PCB Design	4	5
	Total	**30**	**40**

* There could be minor deviation in mark distribution.

Reference:

1. Omura,George & Benton,Brian (2019). Mastering AutoCAD 2019 and AutoCAD LT 2019.
2. Philips, Kendrol (2020). AutoCAD beginner's guide to 2D and 3D drawings.
3. Sham Tickoo; “AutoCAD 2013 for Engineers and Designers” Dream tech press, New Delhi, Latest edition.
4. Muhammad H. Rashid; “Introduction to PSpice Using OrCAD For Circuits And Electronics” PHI Learning, New Delhi, Latest edition.

Digital Logic
EG2104EEX

Year: II **Total: 7 hours /week**
Part: I **Lecture: 3 hours/week**
Tutorial: 1 hour/week
Practical: hours/week
Lab: 3 hours/week

Course Description:
This course presents an introduction to Digital logic techniques and its practical application in computer and digital system for the students of diploma level who have completed either SLC or equivalent SLC (technical SLC).

Course Objective:
After completing this course, the students will be able to:
1. Explain conversion of different number systems and codes.
2. Explain logic functions and gates.
3. Perform combinational logic design.
4. Perform sequential logic design.
5. Perform Industrial application of logic system.

Unit 1. Introduction to Digital Logic **[4 Hrs.]**
- 1.1. Analog versus Digital Signals
- 1.2. Logic Level Diagram
- 1.3. Digital Integrated Circuits (ICs)
- 1.4. Clock Triggering Systems
- 1.5. Digital Logic Applications

Unit 2. Digital Codes and Conversions **[4 Hrs.]**
- 2.1. Decimal, Binary, Octal and Hexadecimal Codes
- 2.2. BCD Code
- 2.3. Excess-3 Code
- 2.4. Gray Code
- 2.5. ASCII and EBCDIC Codes
- 2.6. Different Code Conversions

Unit 3. Arithmetic Logic Operations **[7 Hrs.]**
- 3.1. Binary Arithmetic
- 3.2. Binary Addition
- 3.3. Binary Subtraction
- 3.4. 9's and 10's Complement Method
- 3.5. 9's Complement Subtraction
- 3.6. 10's Complement Subtraction
- 3.7. 1's Complement and 2's Complement Method
- 3.8. 1's Complement Subtraction
- 3.9. 2's Complement Subtraction

Unit 4. Logic Gates [4 Hrs.]

4.1. Basic Gates and Equivalents
4.2. Universal Gates and Equivalents
4.3. Exclusive Gates and Equivalents
4.4. Positive and Negative Logic
4.5. Introduction to 74XX and 74CXX ICs
4.6. De' Morgan's Theorems
4.7. Applications of Universal Gates

Unit 5. Logic Simplifications [5 Hrs.]

5.1. Boolean Algebra and its Laws
5.2. Simplifications of Boolean Expressions
5.3. Truth Tables and Karnaugh's Map
5.4. Cell, Pairs, Quads and Octets
5.5. Rolling, Envelop Effects and Redundant Groups
5.6. Don't Care Conditions
5.7. Sum-of- Product and Product-of-Sum Methods

Unit 6. Combinational Logic Circuits [8 Hrs.]

6.1. Design Procedures
6.2. Adders: Half-Adder and Full-Adder
6.3. Subtractors: Half-Subtractor and Full-Subtractor
6.4. Multiplexers and Demultiplexers
6.5. Encoders and Decoders
6.6. BCD-to-Decimal Decoders
6.7. Seven-Segment Decoders
6.8. Applications

Unit 7. Sequential Logic Circuits [5 Hrs.]

7.1. Latches and Flip-Flops
7.2. Excitation Tables
7.3. Characteristic Equations
7.4. Flip-flop Timing Diagrams
7.5. Flip-Flops as State Machines
7.6. Flip-Flop Classifications based on Triggering Systems
7.7. Applications

Unit 8. Registers and Counters [8 Hrs.]

8.1. Register and its types
8.2. SISO, SIPO, PISO and PIPO Registers
8.3. Data Transfer Timing Diagrams
8.4. Asynchronous Counters
8.5. Asynchronous Up, Down, Up/Down and Mod-Counters
8.6. Decade/BCD Counters
8.7. Synchronous Counters
8.8. Synchronous Up, Down, Up/Down and Mod-Counters

8.9. Applications

Practical: **[45 Hrs.]**

Lab 1. Verify the truth table of different gates.
Lab 2. Verify De' Morgan's Law, familiarization with NAND and NOR gates and realization of universal gates.
Lab 3. Verify half-adder/ half subtractor and full-adder/full-subtractor
Lab 4. Verify encoders and decoders.
Lab 5. Verify multiplexers and demultiplexers.
Lab 6. Verify latches, RS, master-slave and T flip-flops.
Lab 7. Verify D and JK type flip-flops.
Lab 8. Verify various types of shift register circuits.
Lab 9. Verify ripple counter and synchronous counters.

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	Introduction to Digital Logic	4	7
2	Digital Codes and Conversions	4	7
3	Arithmetic Logic Operations	7	13
4	Logic Gates	4	7
5	Logic Simplifications	5	9
6	Combinational Logic Circuits	8	14
7	Sequential Logic Circuits	5	9
8	Registers and Counters	8	14
	Total	**45**	**80**

* There could be minor deviation in mark distribution.

References:

1. T. Floyd, "Digital Fundamentals", John Willy & Sons Pvt. Ltd., 6th Edition, 2006.
2. M. M. Mano, "Digital Design", McGraw-Hill Publication, Delhi, 4th Edition 2007.
3. Donald P. Leach, Albert P. Malvino and Goutam Saha, "Digital Principles and
4. Applications," 7th Edition, Tata McGraw-Hill, 2012.
5. David J. Comer, "Digital Logic and State Machine Design", 3rd Edition, Oxford University Press, 2002.
6. William I. Fletcher, "An Engineering Approach to Digital Design", Printice Hall of India, New Delhi, 1990.
7. William H. Gothmann, "Digital Electronics, An Introduction to Theory and Practice", 2nd Edition, PHI, 2009.

Second Year/Second Part

S.N.	Course Code	Subject
1	EG2201EE	Microprocessors
2	EG2203EE	Electric Circuit Analysis
3	EG2201EEX	Electronics Devices and Circuits
4	EG2202EEX	Basic Programmable Logic Control (PLC)
5	EG2206EE	Electrical Machines I
6	EG2207EE	Electrical Instruments and Measurements
7	EG2203EX	Repair and Maintenance of Consumer Appliances I

Microprocessor
EG2201EE

Year: II **Total: 6 hours /week**
Part: II **Lecture: 3 hours/week**
Tutorial: 1 hour/week
Practical: hours/week
Lab: 2 hours/week

Course Description:
This course deals with fundamentals of microprocessor, basic low-level microprocessor programming, interfacing and introduction to basic programmable devices.

Course Objectives:
After completing this course, the students will be able to:
1. Describe the working principle of a computer
2. Discuss the working principle of microprocessor (8 bit and 16 bit)
3. Explain the process of writing and executing low level language
4. Interface devices with a computer.

Course Contents:

Theory

Unit 1. Introduction to Microprocessor and Microcontroller [9 Hrs.]
- 1.1. Introduction, evolution and Need of Microprocessor
- 1.2. Different Microprocessor Architecture: RISC and CISC
- 1.3. Introduction to Microcontroller, Microprocessor versus Microcontroller
- 1.4. Criteria for Choosing a Microcontroller
- 1.5. Microprocessor based system and bus organization
- 1.6. Stored program concept and Von Neumann Machine

Unit 2. Basics of 8085 Microprocessor [12 Hrs.]
- 2.1. Features, internal architecture, pin description, internal registers, ALU and control unit
- 2.2. Addressing Modes, Instruction Sets, 8085 interrupts: Software and Hardware interrupts, Interrupt Priorities, 8259 programmable Interrupt Controller
- 2.3. Programming with 8085: Data transfer, arithmetic and logical operations

Unit 3. Memory & I/O Interfacing [12 Hrs.]
- 3.1. Memory device classification and hierarchy, Memory mapping and addressing, I/O Mapped I/O and Memory Mapped I/O
- 3.2. Parallel Interface
  - 3.2.1. Modes: Simple, Wait, Single Handshaking and Double Handshaking
  - 3.2.2. Introduction to Programmable Peripheral Interface (PPI)
- 3.3. Serial Interface
  - 3.3.1. Synchronous and Asynchronous Transmission
  - 3.3.2. Serial Interface Standards: RS232
  - 3.3.3. Introduction to USART
  - 3.3.4. Universal Serial Bus (USB)
- 3.4. Introduction to Direct Memory Access (DMA) and DMA Controller

Unit 4. Microcontrollers [12 Hrs.]

4.1. Introduction, Block diagram of Microcontroller
4.2. Comparison between different types of microcontrollers
4.3. Introduction and comparison to 8051, AVR and PIC microcontrollers families
4.4. Concept of interfacing with keyboards, LEDs, LCDs etc.
4.5. Introduction to Arduino, Raspberry Pi

Practical: [30 Hrs.]

1. Familiarize with 8085 microprocessors and run a program using data transfer instruction for immediate data transfer and data transfer between registers.
2. Write and execute a program for 8085 microprocessor using data transfer instruction for data transfer from/to memory and I/O.
3. Write and execute a program for 8085 microprocessor using arithmetic instruction for addition
4. Write and execute a program for 8085 microprocessor using arithmetic instruction for subtraction.
5. Write and execute a program for 8085 microprocessor using logical instruction for AND, OR, XOR and Complement.
6. Write and execute a program for 8085 microprocessor using logical instruction for rotation.
7. Write a program to find square of a number using look-up table.
8. Write a logic program to find the factorial of a given number.
9. Write a program to control LEDs connected at output port of 8051 microcontroller
10. Write a program to speed of dc shunt motor
11. Write and execute a program for traffic light control.

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	Introduction to Microprocessor and Microcontroller	9	17
2	Basics of 8085 Microprocessor	12	21
3	Memory & I/O Interfacing	12	21
4	Microcontrollers	12	21
	Total	**45**	**80**

* There could be minor deviation in mark distribution.

References:

1. Douglas V Hal, 'Microprocessor and Interfacing, Programming and Hardware' TMH 2006
2. Liu and Gibson,' Micro computer System 8086/8088 family architecture, programming and design' PHI 2nd edition.
3. K Uma Rao,The 8051 Microcontroller, architecture, programming and applications, Pearson 2009.
4. Ramesh S. Gaonkar, "Microprocessor Architecture, Programming and Application with 8085", 5th Edition 2002, Prentice Hall

Electric Circuit Analysis

EG2103EE

Year: II **Total: 6 hours /week**

Part: II **Lecture: 3 hours/week**

Tutorial: 1 hour/week

Practical: hours/week

Lab: 2 hours/week

Course Description:

This course elaborates the electric network theorems and incorporates fundamental concepts of AC networks along with three phase systems.

Course Objectives:

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

1. Explain the basic circuit theorems and their application for analysis of DC networks
2. Describe AC circuits and analysis of AC networks
3. Describe the 3 phase AC systems and their application

Course Contents:

Theory

Unit 1. DC Network Theorems and Circuit Analysis [11 Hrs.]

1.1. Thevenin's theorem
1.2. Nortorn's theorem
1.3. Superposition theorem
1.4. Maximum power transfer theorem
1.5. Mesh current method of circuit analysis
1.6. Node voltage method of circuit analysis

Unit 2. AC Fundamentals [24 Hrs.]

2.1. Generation of alternating voltage & currents, equations of alternating voltage & currents, Sine Wave.
2.2. Terminologies: Frequency, time period, amplitude angular velocity, average value, rms value, phase & phase differences.
2.3. Average & amp;rms value of different waves
2.4. Representation of alternating quantities vector diagram, Vector diagram of sine waves of same frequency, addiction & subtraction of two alternating quantities, different form of vector such as trigonometrically form, polar form, Cartesian form. Use of 'J' operator and its significance.
2.5. AC through pure ohmic Resistance, phaser diagram, waveform of current & voltage, power & necessary mathematical expression with analysis
2.6. AC through pure inductance only, phaser diagram, waveform of current, voltage, power & necessary mathematical expression with
2.7. analysis.
2.8. AC through pure capacitor only, phaser diagram, waveform of current, voltage, power & necessary mathematical expression with analysis.
2.9. Analysis of series R-L, R-C, R-L-C circuits
2.10. Analysis of parallel R-L, R-C, R-L-C circuit

2.11. Resonance in AC series circuit
2.12. Resonance in AC parallel circuit

Unit 3. Three phase system [10 Hours]

3.1. Generation of three phase voltages, phase sequence, phase sequence at load, star & delta connection, neutral point.
3.2. Advantages of three phase system.
3.3. Relation between line and phase value of voltage & current in star & delta connections and their phasor diagram.
3.4. Power consumed in three phase circuit.
3.5. Balanced and unbalanced system, Effect of unbalanced load in three phase system.
3.6. Related numerical problems.

Practical: [30 Hours]

1. Verify maximum power transfer theorems.
2. Handle oscilloscope to measure ac quantities such as peak values, rms value, time period & frequency.
3. Measure voltage, current & power of R-L-C series circuit.
4. Measure voltage, current & power in RL parallel Circuit.
5. Perform resonance analysis of R-L-C series.
6. Analyze of R-L series circuit & R-L series circuit with the help of oscilloscope.
7. Perform 3 phase circuit in star/delta connected balanced load & measurement of power.

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	DC Network Theorems and Circuit Analysis	11	24
2	AC Fundamentals	24	32
3	Three phase system	10	24
	Total	**45**	**80**

* There could be minor deviation in mark distribution.

References:

1. Theraja, B.L. & Theraja, A.K., (2008), "A Textbook of Electrical Technology", Chand (S.) & Co Ltd, India
2. Gupta, J.B., (2010), "Fundamentals of Electrical Engineering", S K KATARIA & SONS
3. Del Toro, Vincent, (2015), "Electrical Engineering Fundamentals", Pearson Education India
4. Cogdell, John R., (1990), "Foundations of Electrical Engineering", Prentice Hall
5. Ashphaq Husain, (2012), "Fundamentals of Electrical Engineering", Chaukhamba Auriyantaliya

Electronics Devices and Circuits

EG2201EEX

Year: II **Total: 6 hours /week**

Part: II **Lecture: 3 hours/week**

Tutorial: 1 hour/week

Practical: 2 hours/week

Lab: hours/week

Course Description:

This course will provide skill and knowledge to Electronics Device and Circuit to the students of diploma II year II semester. The course will familiarize with the principle operation, analysis and design of BJT, FET bias circuits, amplifiers, Oscillators and nonlinear circuits.

Course Objectives:

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

1. Introduce the fundamentals of analysis of electronic circuits
2. Provide basic understanding of Operation of Small signal amplifier.
3. Analyze voltage divider type dc biasing methods.
4. Familiarize with Feedback Amplifier, Operational Amplifier and Power Amplifier.
5. Explain the working principles of Oscillator Circuit and switching regulators.

Course Contents:

Theory

Unit 1. BJT Circuits [9 Hrs.]

1.1. Analysis of Transistor Circuits at DC

1.2. DC biasing - design of β - independent dc biasing method.

1.3. Transfer characteristic

1.4. Transistor as an Amplifier, Amplifier analysis: CB, CE and CC amplifiers

1.5. LC - tuned amplifier: ω_o, BW and Q-factor

1.6. BJT as switch: NOT, NOR and NAND gates.

Unit 2. FET Circuits [7 Hrs.]

2.1. MOSFET Circuits at DC

2.2. MOSFET as an Amplifier

2.3. DC biasing - analysis of voltage divider type dc biasing method– JFET and MOSFET.

2.4. Transfer characteristics, square law formulas:

$i_D = I_{DSS}\left(1 - \frac{V_{gs}}{V_P}\right)^2$ and $i_D = K(V_{gs} - V_t)^2$, i_D and $g_m = i_d v_{gs}$

2.5. FET as switch: NOT, NOR, NAND gates.

2.6. CMOS circuit: NOT,NOR and NAND gate

Unit 3. Feedback Amplifiers [4 Hrs.]

3.1. Feedback concept and principle, Derivation of expression for the gain of an amplifier employing feedback

3.2. Types of Feedback and concept of negative and positive feedbacks in amplifiers
3.3. Effect of negative feedback on gain, stability, distortion and band-width
3.4. Negative feedback circuits
Voltage - series feedback
Voltage - shunt feedback
Current - series feedback
Current - shunt feedback
3.5. Positive feedback
3.6. Application in oscillators, schmitt triggers and multivibrators

Unit 4. Operational Amplifiers [5 Hrs.]

4.1. Concept of Opamp, schematic. working principle and its block diagram
4.2. Properties of ideal opamp
4.3. Construction and operation of differential amplifier, level-shifting and output stage.
4.4. Inverting and non-inverting amplifiers
4.5. Summing and Subtracting amplifier
4.6. IC OP-AMP Application

Unit 5. Power Amplifier and Heat Sink [5 Hrs.]

5.1. Difference between voltage and power amplifier, Performance parameters, Classification of power amplifiers (class A, B, AB & C)
5.2. Class A amplifiers with resistive load and transformer load, Collector efficiency and overall efficiency.
5.3. Class B amplifier with transformer coupling, Collector efficiency and overall efficiency.
5.4. Class B and class AB amplifiers:
5.4.1. Working principle of Direct coupled and complementary symmetry push pull circuit and its advantages
5.5. IC power amplifiers application.
5.6. Distortion in amplifiers and Heat sinks, working principle and its importance.

Unit 6. DC Voltage Regulator/ Regulated Power Supply [6 Hrs.]

6.1. Unregulated Power Supply: Concept and working principle
6.2. Zener diode as voltage Stabilizer.
6.3. Basic voltage regulators using BJT and opamp
6.4. Maximum output power rating and short circuit protection circuit.
6.5. Concept of series and shunt regulator circuits.
6.6. Three terminal Integrated Circuit Voltage Regulator: LM317 , LM 337 , 78XX, 79XX families , Block Diagram, Pin Configuration and application.
6.7. Switching regulators (SMPS): Concept, working principle and Simple Circuit diagram

Unit 7. Oscillators and Non-linear Circuits (Applications of BJT, FET and opamp) **[9 Hrs.]**

7.1. Use of positive feedback for generation of oscillations, Barkhausen criterion for oscillations, Application of oscillators

7.2. Basic Principles of Sinusoidal Oscillator

7.3. Construction, principle of operation and working of Wein-bridge and crystal oscillators.

7.4. Schmitt trigger and Astable multivibrator circuits.

Practical: **[30 Hrs.]**

1. Review the use of laboratory equipment, electronic devices and PCB circuits
2. Construct and analyze BJT and FET amplifier circuits. Determine the voltage gain, input resistance and output resistance.
3. Use of Op-Amp. (for IC-741) as Inverting and non-inverting amplifier, adder, comparator, buffer, scale changer.
4. Construct sine wave and square wave oscillator circuits using opamp (741). Measure the output voltage and frequency of oscillation, and compare them with calculated values using formula.
5. Construct rectangular, square and triangular waves oscillator circuits using ICS 555 and 556. Compare the output frequency of measured value and calculated value using appropriate formula.
6. Construct and analyse series DC voltage regulators using BJT and Zener diode, and LM317/LM337 IC. Determine the output voltage (VO) and voltage stability factor (SV).
7. Lab7: Construct and analyse IC power amplifier circuit. Measure maximum power output. *Note: Use IC : TDA2003, LM380*
8. Construct non-inverting amplifier and summing amplifier circuits. Determine input and output voltages' relationship.

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	BJT Circuits	9	16
2	FET Circuits	7	12
3	Feedback Amplifiers	4	7
4	Operational Amplifiers	5	9
5	Power Amplifier and Heat Sink	5	9
6	DC Voltage Regulator/ Regulated Power Supply	6	11
7	Oscillators and Non-linear Circuits (Applications of BJT, FET and opamp)	9	16
	Total	**45**	**80**

* There could be minor deviation in mark distribution.

Reference:

1. Bhargava, Kulshreshtha & Gupta – "Baisc Electronics & Linear Circuits" – Tata Mcgraw-Hill.
2. Malvino, A. P. – "Electronics Principles" – Tata Mcgraw-Hill.
3. David A. Bell, Laboratory Manual for Electronic Devices and circuits
4. David A.Bell, " Electronics Device and Circuits ", PHI; 3rd Edition, 1999.
5. Robert Boylestad and Louis Nashelsky, " Electronic Device and Circuit Theory", PHI; 9th Edition, 2007
6. Thomas L. Floyd, "Electronic Devices", 8th Edition, Pearson Education Inc., 2007
7. Theodore F. Bogart, Electronic Devices and Circuits.
8. Jacob Millman and Christos C. Halkias,and Satyabrata Jit "Millman's Electronic Device and Circuits", Tata McGraw- Hill; 2nd Edition, 2007

Basic Programmable Logic Control (PLC)

EG2202EEX

Year: II **Total: 6 hours /week**

Part: II **Lecture: 3 hours/week**

Tutorial: 1 hour/week

Practical: hours/week

Lab: 2 hours/week

Course Description:

This course is designed to provide fundamental concepts of PLC, Ladder programming using functions of PLC and its applications and simulations.

Course Objectives:

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

1. Interpret the structure of a PLC, and its various components
2. Design a PLC system, component, or process to meet a set of specifications.
3. Explain of the role of PLCs in safety critical systems.
4. Illustrate a PLC simulation software package.
5. Utilize this software package to solve problems on a wide-range of PLC problems.

Course Contents:

Theory

Unit 1. Introduction to Programmable Controllers [10 Hrs.]

1.1. Definition, history of electric, electronic and PLC control
1.2. PLCs versus Other Types of Controls advantage and disadvantage
1.3. Architecture Detail of PLC and Control System Components, principle of operation
1.4. PLC Product Application Ranges
1.5. Ladder Diagrams and the PLC
1.6. PLC Circuits and Logic Contact Symbol
1.7. Configuring the PLC Memory—I/O Addressing
1.8. PLC Instructions for Discrete Inputs
1.9. PLC Instructions for Discrete Outputs
1.10. PLC operation-Scan Time, Watch Dog Timer

Unit 2. PLC Logic, Timer, Counter Functions [5 Hrs.]

2.1. Introduction to PLC programming
2.2. Programming Logic Gate Functions and its basic applications
2.3. Retentive timers, Nonreactive timers and timer applications
2.4. Basic counter functions, Counter applications

Unit 3. PLC Math Functions [3 Hrs.]

3.1. Addition, Subtraction, Multiplication, Division
3.2. Square root, Scaling, Absolute value, X to the power of Y
3.3. Natural Logarithm, Base 10 logarithm-4, Sine, Cosine, Tangent

Unit 4. PLC Logic Functions [5 Hrs.]

4.1. Bit functions

4.2. Shift and rotate functions
4.3. PLC Compare, Jump, and MCR Functions
4.4. PLC Subroutine Functions
4.5. PLC Sequencer Functions

Unit 5. PLC Interrupts [4 Hrs.]
5.1. The principle and the structure of interrupt function
5.2. Application of interrupt service routine
5.3. Interrupt source, label and priority
5.4. Interrupt configuration and examples of interrupt routing

Unit 6. Process Control [6 Hrs.]
6.1. Features of PLC based process control
6.2. Point of Loop Controller
6.3. internal mechanism of Loop Controller
6.4. Outline of Procedures to build PLC-based Process Control System

Unit 7. Automation and data analysis [6 Hrs.]
7.1. PLC base Home automation, Industrial Automation
7.2. Introduction to SCADA and DCS
7.3. Human Machine Interface

Unit 8. PLC Networks [6 Hrs.]
8.1. Serial networks (RS-232, RS-485)
8.2. TCP/IP networks

Practical [30 Hrs.]
1. Make program for logic function and make any application using logic functions of PLC. (For ex. water level control, sensor operated light control, alarms etc.)
2. Make program for timer, counter, move, math, 7 segment display, encoder, decoder and other required functions and make any application. (For ex. traffic light, tank filling, motor, stepper motor control, security systems)
3. Make program for, bit, shift, rotate, jump, subroutine, sequencer function and make any application. (For ex. moving display, simple industrial, home automation)
4. Make a large-scale project for industry automation using process control, human machine interface.

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	Introduction to Programmable Controllers	10	18
2	PLC Logic, Timer, Counter Functions	5	9
3	PLC Math Functions	3	5
4	PLC Logic Functions	5	9
5	PLC Interrupts	4	6

6	Process Control	6	11
7	Automation and data analysis	6	11
8	PLC Networks	6	11
	Total	**45**	**80**

* There could be minor deviation in mark distribution.

References:

1. M. Rabiee. (2002) Programmable Logic Controllers: Hardware and Programming, Good heart-Willcox,
2. L. A. Bryan and E. A. Bryan (1997) Programmable Controllers (Theory and Implementation). Industrial Text Co.
3. Bolton W. (2015) Programmable-Logic-Controllers. Newnes
4. Kelvin T. Ericson (2016). Programmable Logic Controllers: An Emphasis on Design and application. Dogwood Vally Press
5. Frank Petruzella. (2016) Programmable Logic Controller. McGraw Hill

Electrical Machines I

EG2206EE

Year: II **Total: 6 hours /week**
Part: II **Lecture: 3 hours/week**
Tutorial: 1 hour/week
Practical: hours/week
Lab: 2 hours/week

Course Description:
This course covers the electrical machines, transformer, dc generator and dc motor. It deals with the constructional details, operating principle, characteristics, testing methods of the above machines.

Course Objectives:
After completion of this course, student will be able to

1. Explain the basic constructional details of single-phase transformer, three-phase transformer and dc machine, operation and characteristics of single-phase transformer, three-phase transformer, dc generator and dc motor, equivalent circuit of transformer and dc machines, testing of transformer.

Course Contents:

Theory

Unit 1. Single Phase Transformer [14 Hrs.]

1.1 Operating Principle, Basic construction, operation, derivation of emf equation, Transformation ratio, Concept of ideal transformer.
1.2 Constructional Details: Core type and shell type core construction, stepped type core cross-section, Types of windings.
1.3 No-load operation: phasor diagram, equivalent circuit for no-load operation
1.4 Operation of transformer with load: Magnetic circuit condition, amp-turn balance.
1.5 Mutual and leakage fluxes, leakage reactance.
1.6 Capacity of transformer: Definition, factors affecting the capacity of transformer.
1.7 Equivalent circuit: Effect of winding resistance and leakage reactance, equivalent circuit of real transformer, phasor diagram for resistive load and inductive load, transformation of impedance, equivalent circuits refer to primary side and secondary side, percentage impedance, voltage regulation.
1.8 Efficiency of transformer, Losses in transformer, Calculation of efficiency, Condition for maximum efficiency, effect of load power factor on efficiency.
1.9 Testing of transformer – Polarity test, No-load test, Short-circuit test.
1.10 Auto transformer: Operating principle and application.
1.11 Parallel operation of single-phase transformer
1.12 Numerical problems.

Unit 2. Three Phase Transformer [8 Hrs.]

2.1 Introduction: Three units of single-phase transformers used as three-phase transformer, evolution of three-phase transformer.

2.2 Three-phase transformer connections: Star/Star, Delta/Delta, Star/Delta, Delta/Star, Open delta, their phasor group and applications, Relationship between primary and secondary line and phase quantities.
2.3 Parallel operation of three-phase transformers
2.4 Parts of power transformer: Tank, Conservator, Breather, Explosion vent, Transformer oil, Terminal bushing, arching horns, Buchhloz's relay, tap-changer.
2.5 Study of name plate specification of transformer.
2.6 Difference between power and distribution transformer

Unit 3. DC Generator [13 Hrs.]

3.1 Constructional Details: Yoke, Field poles, Field winding, Armature and its winding.
3.2 Operation, operating principle, emf equation,
3.3 Types of dc generator: Separately excited and self-excited and voltage build-up process, Shunt, series and compound generators, their circuit diagrams, relation between emf generated and load terminal voltage, characteristics and applications.
3.4 Losses and efficiency.
3.5 Armature reaction and method of reducing armature reaction.
3.6 Commutation and methods of improving commutation.
3.7 Application and significance of DC generator
3.8 Numerical problems

Unit 4. DC Motor [10 Hrs.]

4.1 Operation: operating principle, torque equation, back emf, roles of back emf.
4.2 Types of dc motor: Shunt, series and compound, their characteristics and applications.
4.3 Losses and efficiency.
4.4 DC motor starter
4.5 Speed control of dc motor
4.6 Application and significance of DC motor
4.7 Numerical problems

Practical: [30 hours]

Lab 1. Perform the following tests of single-phase transformer and evaluate equivalent circuit parameters. **[6 Hrs.]**
1.1. Turn ratio test
1.2. No-load test
1.3. Short circuit test

Lab 2. Perform load operation of single-phase transformer to calculate efficiency at various loads and voltage regulation. **[2 Hrs.]**

Lab 3. Perform test on a three-phase transformer for various types of connections (Star/Star, Delta/Delta and Star/Delta) and verify the relation between line and phase quantities. **[6 Hrs.]**

Lab 4. Perform polarity test on two separate single-phase transformers to connect the transformers in parallel and study the load sharing. **[2 Hrs.]**

Lab 5. Draw open circuit curve (OCC) of dc shunt generator. Calculate the steady state value of voltage build up at no-load from the graphical analysis and verify it with

experimentally measured value. Determine its critical resistance and critical speed. **[4 Hrs.]**

Lab 6. Measure the parameters and determine the load characteristics and voltage regulation of dc shunt generator and dc compound generator and compare the results. **[2 Hrs.]**

Lab 7. Measure the parameters and determine the load characteristics and voltage regulation of dc series generator. **[2 Hrs.]**

Lab 8. Measure the parameters and draw Speed/armature current, speed/torque and load/efficiency curves on dc shunt motor. **[2 Hrs.]**

Lab 9. **[4 Hrs.]**

9.1. Perform speed control of dc shunt generator by field control method **[2 Hrs.]**

9.2. Perform speed control of dc shunt generator Speed control by armature control method. **[2 Hrs.]**

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	Single Phase Transformer	14	25
2	Three Phase Transformer	8	14
3	DC Generator	13	23
4	DC Motor	10	18
	Total	**45**	**80**

* There could be minor deviation in mark distribution.

References:

- Nagrath I.J. and Kothari D.P., (2017) *"Electric Machines"*, (Third edition), Tata McGraw-Hill publication.
- Gupta J.B., (2013) *"Theory and performance of Electrical Machines"* (Ninth edition), S.K. Kataria & Sons, India.

Electrical Instruments and Measurements

EG2207EE

Year: II **Total: 6 hours /week**

Part: II **Lecture: 3 hours/week**

Tutorial: 1 hour/week

Practical: hours/week

Lab: 2 hours/week

Course Description:

This course covers the electrical machines-transformer, dc generator and dc motor. It deals with the constructional details, operating principle, characteristics, testing methods of the above machines.

Course Objectives:

After completion of this course the student will be able to:

1. Explain the construction and operating principles of various types of measuring instruments (e.g. moving coil, moving iron, electro-dynamometer, and induction type) for measurement of voltage, current, power, resistance, energy, power factor and frequency.
2. Measure R, L and C using different types of bridge.
3. Measure non-electrical quantities e.g. temperature, illumination, distance, velocity, strain etc.

Course Contents:

Theory

Unit 1. Electrical Measuring Instrument [8 Hrs.]

1.1. Introduction to measurement and Instruments.
1.2. Measurement of electrical quantities and instrument for their measurements, Sources of error.
1.3. Types and application of indicating, recording and integrating type instruments.
1.4. Essential features of indicating instruments (deflecting, balancing and damping torque).
1.5. Moving coil instrument – construction, operating principle and application.
1.6. Moving iron instrument – construction, operating principle and application.
1.7. Electro dynamometer instrument – construction, operating principle and application

Unit 2. Measurement of Resistance, Inductance and Capacitance [6 Hrs.]

2.1. Classification of resistance.
2.2. Measurement of low resistance using ammeter and voltmeter method and Kelvin double bridge method.
2.3. Measurement of medium resistance using Wheatstone bridge method.
2.4. Measurement of high resistance and continuity using Megger.
2.5. Maxwell's bridge for inductance measurement.
2.6. De Sauty bridge and Schering bridge for capacitance measurement.

Unit 3. Extension of measuring range of instruments [4 Hrs.]

3.1. Shunts and Multipliers – use and characteristics.
3.2. Multi-range meters – ammeter, voltmeter, ohmmeter and multimeter.

Unit 4. Potentiometer [4 Hrs.]

4.1. Operating principle, construction, connection into electric circuit and application of d.c. potentiometer.
4.2. Operating principle, construction, and application of inductive potentiometer

Unit 5. Measurement of Power, Energy and Frequency [8 Hrs.]

5.1. Power measurement in single-phase with wattmeter and three-phase with two and three wattmeter methods.
5.2. Reactive power measurement using VAR meter.
5.3. Single-phase and three phase energy measurement using single and three phases energy meter.
5.4. Measurement of frequency using frequency meter.
5.5. Measurement of maximum demand using maximum demand meter.
5.6. Application of 'Time of Day' (TOD) meter

Unit 6. Measuring Instruments for measurement of Non-electrical Quantities. [6 Hrs.]

6.1. Thermocouple – construction, operation and application in measurement of voltage or current.
6.2. Lux-meter – construction, operation and application in measurement of illumination on working plane.
6.3. Piezometer – construction, operation and application.
6.4. Transducers – construction, operation and application in measurement of distance, velocity and strain.

Unit 7. Electronic Instrument [3 Hrs.]

7.1. Cathode-ray Oscilloscope – basic construction, operation and application.
7.2. Digital multimeter – only block diagram and applications.

Unit 8. Instrument Transformers [4 Hrs.]

8.1. Current transformer – operating principle, construction, characteristics and application in measurements.
8.2. Potential transformer – operating principle, construction, characteristics and application in measurements.

Unit 9. Smart metering system [2 Hrs.]

9.1. Introduction to Smart metering technology: AMR (Automatic Metering Reading), MRI (Meter Reading Instrument).
9.2. Introduction to AMI (Advanced metering infrastructure), functions of AMI, cyber Security.

Practical: [30 Hrs.]

Lab 1. Measure d.c. voltage and current using moving coil instrument with shunt and multiplier.

[4 Hrs.]

Lab 2. Measure voltage, current and power using electro-dynamometer and compare with the result of power factor meter. **[6 Hrs.]**

Lab 3. Measure energy for single/three phase system using kWhr meter for the inductive Load. Check the accuracy. **[6 Hrs.]**

Lab 4. Measure resistance using bridge, potentiometer and ammeter voltmeter method and compare the results. **[6 Hrs.]**

Lab 5. Measure inductance and capacitance using a.c. bridge. **[6 Hrs.]**

Lab 6. Measure temperature using thermocouple. **[2 Hrs.]**

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	Electrical Measuring Instrument.	8	14
2	Measurement of Resistance, Inductance and Capacitance.	6	11
3	Extension of measuring range of instruments.	4	7
4	Potentiometer.	4	7
5	Measurement of Power, Energy and Frequency.	8	14
6	Measuring Instruments for measurement of Non-electrical Quantities.	6	11
7	Electronic Instrument.	3	5
8	Instrument Transformers.	4	7
9	Smart metering system.	2	4
	Total	**45**	**80**

* There could be minor deviation in mark distribution.

References:

1. A.K. Sawhney (2021), "A Corse in Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai & Sons
2. Lion, Kurt S., (1977), "Elements of Electrical and Electronic Instrumentation" McGraw-Hill Education; International Ed edition
3. GOLDING AND WIDDIS (2011), "Electrical Measurements and Measuring Instruments", Reem Publications Pvt. Ltd.
4. B.A. Gregory (1981), "An Introduction to Electrical Instrumentation and Measurement System'', Palgrave HE UK; 2nd edition

Repair and Maintenance of Consumer Appliances I

EG2203EEX

Year: II **Total: 4 hours /week**

Part: II **Lecture: 1 hours/week**

Tutorial: hour/week

Practical: 3 hours/week

Lab: hours/week

Course Description:

This course deals with the procedure of testing, repairing of essential domestic electrical equipment.

Course Objectives:

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

1. Test and identify the fault of appliance
2. Repair and Replace the faulty part
3. Reform and supervise repair work
4. Read and prepare circuit diagram
5. Repair and maintenance of PC.

Course Contents:

Theory

Unit 1. Repair and maintenance of heating equipment [3 Hrs.]

1.1. Automatic iron: Operating principle, circuit diagram and list of parts of Automatic iron, Definition and purposes of repair and maintenance, review of continuity test, body leakage test in brief.

1.2. Fan Heater (Room heater): Introduction of Fan and Heater, circuit diagram and listing the components of fan heater.

1.3. Electric Kettle**:** Circuit diagram of electric kettle and listing its' parts.

Unit 2. Repair and maintenance of battery charger [1 Hrs.]

2.1. Transformer, Electronic circuit, rectifiers-filter control, hydrometer, continuity test - Leakage test, Disassembling and assembling, Final test

Unit 3. Repair and maintenance of kitchen appliances [3 Hrs.]

3.1. Toaster: Circuit diagram and its' components. Introduction to latching device and Thermostat/ Timer.

3.2. Rice Cooker: Circuit diagram and listing its' components. Brief theory on Thermal fuse, magnetic switch, Bi-metallic thermostatic switch ON/OFF switch and indicator cooking element, warmer element.

3.3. Grinder/mixer/ juicer and dryer: Introduction to Grinder/mixer/ juicer and dryer, Circuit diagram and listing its' components, Review of applicable motor (if any) on these electrical appliances.

Unit 4. Repair and maintenance of Geyser, Refrigerator and air conditioner [2 Hrs.]

4.1. Geyser: Introduction to Geyser, Circuit diagram and listing the components of geyser, brief theory on earth and its' testing.

4.2. Refrigerator and air conditioner: Introduction to refrigerator and air conditioner, Lay out diagram and its components. Assemble and disassemble, brief review on centrifugal switch, relays- fuses- thermostat door switch, defrosting system, and timer.

Unit 5. PC Troubleshooting and Maintenance [4 Hrs.]

5.1. Introduction to Personal computer and peripheral devices, Software: Introduction, types: System, utility, application and examples, different types of ports and cables used in PC.

Practical:

1. Repair maintenance of automatic electric iron. [2 Hrs.]

1.1. Disassembling automatic electric iron.
1.2. Test of switches, heating element, plug leads, thermostat, ceramic glass (if any) by using multimeter and visual inspection.
1.3. Maintenance and replace (if any).
1.4. Assemble all components
1.5. Final test.

2. Repair maintenance of Fan Heater (Room heater). [3 Hrs.]

2.1. Disassemble Fan Heater (Room heater).
2.2. Test of the heating and cooling system, Single rod heater, two rod heat heater ON/OFF switch, gang switch, rotary switch, thermostat indicator by using multimeter and visual inspection.
2.3. Maintenance and replace (if any).
2.4. Assemble all components.
2.5. Final test.

3. Repair maintenance of Electric Kettle [3 Hrs.]

3.1. Disassemble electric kettle.
3.2. Test of the body, heating element, on/off switch, thermostat, ceramic glass (if any), power connection and options (like temperature sensors), indicators by using multimeter and visual inspection.
3.3. Maintenance and replace (if any).
3.4. Assemble all components.
3.5. Final test.

4. Repair maintenance of Toaster. [3 Hrs.]

4.1. Disassemble Toaster.
4.2. Test of heating element, latching device, Thermostat/ Timer, power connection and options (like temperature sensors), indicators by using multimeter and visual inspection.
4.3. Maintenance and replace (if any).
4.4. Assemble all components.
4.5. Final test.

5. Repair maintenance of Rice Cooker [3 Hrs.]

5.1. Disassemble rice cooker.

5.2. Test of Thermal fuse, magnetic switch, Bi-metallic strip/thermostatic switch, ON/OFF switch, indicators, cooking element, warmer element, ceramic glass (if any), power connection and options (like temperature sensors), indicators by using multimeter and visual inspection.
5.3. Maintenance and replace (if any).
5.4. Assemble all components.
5.5. Final test.

6. Repair maintenance of Grinder/mixer/ juicer and dryer [3 Hrs.]

6.1. Disassemble Grinder/mixer/ juicer and dryer.
6.2. Test of Armature winding, field winding, capacitor (if any), limit switch, carbon brush, holders, power connection and options (like temperature sensors), indicators by using multimeter and visual inspection.
6.3. Maintenance and replace (if any).
6.4. Assemble all components.
6.5. Final test.

Note: optional job can use for demonstration.

7. Repair maintenance of Battery Charger [3 Hrs.]

7.1. Disassemble Battery charger.
7.2. Test of Parts-Transformer, Electronic circuit, rectifiers-filter control, hydrometer power connection and indicators by using multimeter and visual inspection.
7.3. Repair and replace (if any).
7.4. Assemble all components.
7.5. Final test.

8. Repair maintenance of Geyser [3 Hrs.]

8.1. Disassemble Geyser.
8.2. Test of heating element, switches, water flow switch, power connection and options (like temperature sensors), indicators by using multimeter and visual inspection.
8.3. Maintenance and replace (if any).
8.4. Assemble all components.
8.5. final test.

9. Repair maintenance of Refrigerator and air conditioner [4 Hrs.]

9.1. Disassemble Refrigerator and air conditioner.
9.2. Test of Parts- motors windings, capacitor, centrifugal switch, relays- fuses-thermostat door switch, defrosting system, and timer, power connection and options (like temperature sensors), indicators by using multimeter and visual inspection.
9.3. Repair and replace (if any).
9.4. Assemble all components.
9.5. Final test.

10. Install Software and hardware [6 Hrs.]

10.1. Install new PC: connect CPU, Monitor, Mouse, Keyboard, Power Supply, Printer.
10.2. Install Operating System such as windows
10.3. Install Microsoft office package, device driver software
10.4. Install antivirus, Virus checking and clearing

11. **Troubleshoot the PC Problems** **[6 Hrs.]**
    11.1. Troubleshoot the problems of SMPS Power supply
    11.2. Troubleshoot the problems of Mother board
    11.3. Troubleshoot the hard disk issues
    11.4. Troubleshoot the Keyboard and Mouse issues
    11.5. Install/Replace Hardware Module

12. Troubleshoot in the Software system **[6 Hrs.]**
    12.1. Troubleshoot in the OS (Booting System)
    12.2. Troubleshoot in the utility software
    12.3. Troubleshoot in the application software
    12.4. Troubleshoot in the file recovery

References:

1. Bakshi, U. A., & Bakshi, M. V. (2020). *Electrical Machines-I*. Technical Publications.
2. Bakshi, U. A. (2020). *Electrical Machines-II.* Technical Publications.
3. Gupta, J. B. (2009). *Theory & Performance of Electrical Machines*. SK Kataria and Sons.
4. Bertoldi, P., Ricci, A. & de Almeida, A. (2001*). "Energy Efficiency in household appliances and lighting".* Springer Science & Business Media.
5. Bhatia K.B. (2002). *Practical A.C. and D.C. Motor Winding*. Standard Publishers Distributors.
6. Rosenberg R. (1970). *Electrical Motor Repair*. Holt, Rinehart and Winston.
7. Vinogradov, N.V. (1970). *The Industrial Electrician*. Mir Publishers, Moscow.
8. Hanumanthappa, S. & Javaraiah, H. (2018), *A Guide book: PC Maintenance, Troubleshooting and Repair*. LAP LAMBERT Academic Publishing.
9. Rosenthal, J. (2003). *PC Repair & Maintenance A Practical Guide*. CHARLES RIVER MEDIA.

Third Year/First Part

S.N.	Course Code	Subject
1	EG3101EE	Switch Gear and Protection
2	EG3102EE	Power Electronics
3	EG3103EE	Electrical Machines II
4	EG3101EEX	Minor Project
5	EG3102EEX	Digital Electronics Circuit
6	EG3103EEX	Repair and Maintenance of Consumer Appliances II
7	EG3104EEX	Communication System I

Switchgear and Protection

EG3101EE

Year: III **Total: 6 hours /week**

Part: I **Lecture: 4 hours/week**

Tutorial: hour/week

Practical: hours/week

Lab: 2 hours/week

Course Description:

The course deals with the power system protection components, their characteristics and application for proper detection and disconnection of the faulty part.

Course Objectives:

After completing this course, the students will be able to:

1. Find out the faults that may happen in a power system
2. Use various protecting devices e.g. Fuse, MCB, relay and circuit breakers
3. Install and maintain different protecting devices
4. Perform the short circuit analysis of typical power system

Course Contents:

Theory

Unit 1. The general concept of protection system [8 Hrs.]

1.1. Nominal ratings, abnormal conditions and need of protection system in power system
1.2. Short-circuit and their harmful effects
1.3. Open circuit and their consequences
1.4. Characteristics and type of protecting devices
1.5. Example of protection against short circuit
1.6. Causes and consequences of faults, zones and type of protection

Unit 2. Short Circuit Faults [12 Hrs.]

2.1. Definition, reason and consequence of faults in power system
2.2. Concept of short circuit fault current and fault MVA
2.3. Representation of power system for fault calculation: per unit system, reactance diagram and fault calculation
2.4. Short circuit in different sections (generator, bus bar, transmission/distribution lines) and their consequences.

Unit 3. Protection system components [10 Hrs.]

3.1. Fuses
  3.1.1. Fuse elements and their time current characteristics
  3.1.2. Current ratings of fuses, fusing current, fusing factor, Prospective current, cut off current, Pre-Arcing Time, Arcing Time, Breaking Capacity, Total Operating time and related numerical
  3.1.3. Types of Fuse based on construction and uses
3.2. MCB
  3.2.1. Construction characteristics and uses
  3.2.2. Comparison to Fuse

3.3. Contractors
  3.3.1. Construction and operation
  3.3.2. Normally open and close contacts
3.4. Isolator: construction characteristics and uses

Unit 4. Relays and instrument transformers [14 Hrs.]

4.1. Operating principle
4.2. Relay characteristics
  4.2.1. Instantaneous relays
  4.2.2. inverse relays
  4.2.3. IDMT relays
  4.2.4. Plug setting and time setting of relays and related Numerical
4.3. Classification of Relays based on construction
4.4. Electromagnetic induction relay
4.5. Characteristics of Directional relay
4.6. Introduction to static and digital relay
4.7. Buchholzs relay construction and characteristics
4.8. CT and PT
  4.8.1. Application of CT and PT in power system protection
  4.8.2. Standard ratios and accuracy class

Unit 5. Protection scheme [8 Hrs.]

5.1. Application of IDMT relay for HV feeder protection
  5.1.1. Time graded and current graded protection
5.2. Earth fault detection schemes
  5.2.1. Residual CT connection
  5.2.2. Core balance
  5.2.3. Earth lead
5.3. Application of directional relay in loop feeders
5.4. Basic principle of distance protection and protecting zone
5.5. Differential protection schemes for transformers generators and motors
5.6. Buchholz's relay for transformer protection alarm and tripping circuits

Unit 6. Circuit Breakers [8 Hrs.]

6.1. Theory of Arc formation and its extinction (AC and DC), restriking and recovery voltage, Duties of circuit breakers
6.2. Duties of Circuit Breaker
6.3. Specification and Classification of circuit breakers with application
  6.3.1. Air brake circuit breakers
  6.3.2. Oil circuit breakers
  6.3.3. Air blast circuit breakers
  6.3.4. vacuum circuit breakers
  6.3.5. SF6 circuit breakers
6.4. Comparison, Merits and Demerits of different Circuit Breakers
6.5. Working Principle of arc quenching in HVDC circuit Breaker

Practical: **[30 Hrs.]**

1. Demonstrate different types of Fuses
2. Demonstrate Contractors and isolators
3. Draw magnetizing curves for a protective CT, check knee point voltage
4. Identify terminals of CT and make polarity test.
5. Obtain the time current characteristics of an induction disc relay.
6. Test an induction disc relay for earth fault protection.
7. Check connection sensitive earth fault protection scheme.
8. Check connections on a biased differential protection scheme.
9. Demonstrate an air circuit breaker for calibration.
10. Demonstrate oil circuit breaker.

Field visit: Visit a substation and prepare its technical report emphasizing on control side

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	The general concept of protection system	8	11
2	Short Circuit Faults	12	16
3	Protection system components	10	13
4	Relays and instrument transformers	14	18
5	Protection scheme	8	11
6	Circuit Breakers	8	11
	Total	**60**	**80**

* There could be minor deviation in mark distribution.

References:

1. Rao, S.S. (2019). Switchgear and Protection (14th ed.). New Delhi: Khanna Publications.
2. Gupta, J.B. (2007). Switchgear and Protection. New Delhi: Khanna Publications.
3. Ram, B. & Vishwakarma, D.N. (2011). System Protection and Switchgear. New Delhi: McGraw-Hill.

Power Electronics

EG3102EE

Year: III **Total: 5 hours /week**

Part: I **Lecture: 3 hours/week**

Tutorial: hour/week

Practical: hours/week

Lab: 2 hours/week

Course Description:

This course covers the power electronics devices and schemes such as rectifier, chopper, inverter, ac voltage controller applied to electric circuits.

Course Objectives:

After completion of this course, student will be able to:

1. Explain the basic constructional details and operation of power electronic devices- Thyristor, GTO, TRIAC, MOSFET, IGBT,
2. Operate rectifier, chopper, inverter and ac voltage controller.

Course Contents:

Theory

Unit 1. Power Electronics Devices [10 Hrs.]

1.1. Thyristor
- 1.1.1. Construction
- 1.1.2. V-I Characteristics
- 1.1.3. Types of turn on mechanism (list out), Turn-on process with gate signal
- 1.1.4. Resistance and resistance-capacitance firing circuit
- 1.1.5. Natural and forced commutation

1.2. GTO - Construction, Characteristics

1.3. TRIAC – Construction and Characteristics

1.4. MOSFET - Construction and Characteristics

1.5. IGBT - Construction and Characteristics

Unit 2. Power Rectifier [11 Hrs.]

2.1. Half wave and full wave single-phase rectifier
- 2.1.1. Circuit diagram,
- 2.1.2. Operating principle,
- 2.1.3. calculation of average value, RMS value, ripple factor, efficiency,
- 2.1.4. Filtering – C, L and LC filters,
- 2.1.5. Related numerical

2.2. Single-phase full wave-controlled rectifier with resistive load, RL load, and inversion mode of operation.

2.3. Three-phase rectifier with three numbers of diode.

2.4. Three-phase bridge rectifier with six numbers of diode.

Unit 3. DC Chopper [6 Hrs.]

3.1. Step down and step-up chopper
- 3.1.1. Circuit diagram,

3.1.2. Operation with resistive load,
3.1.3. Related numerical

3.2. Constant and variable chopping frequency operation

3.3. Application in speed control dc motor.

Unit 4. Inverter [10 Hrs.]

4.1. Single phase half bridge and full bridge square wave inverter with resistive load
4.1.1. Circuit diagram,
4.1.2. operating principle,
4.1.3. RMS value of output voltage
4.1.4. Related numerical

4.2. Three-phase bridge inverter with six-step output voltage waveform
4.2.1. Circuit diagram,
4.2.2. operation with 180-degree mode of conduction for resistive load,
4.2.3. RMS value of output voltage.

4.3. Application of inverter in speed control of induction motor and synchronous motor.

Unit 5. AC voltage controller [8 Hrs.]

5.1. Single-phase half wave and full wave ac voltage controller – Circuit diagram, operation with resistive load.

5.2. Three -phase ac voltage controller – Circuit diagram, operation with resistive load.

5.3. Applications in speed control of induction motor, Electronic load controller for MHP generator.

Practical: [30 Hrs.]

Lab 1.

1.1. Operate SCR in forward blocking state.
1.2. Operate SCR in forward conduction state by adjusting gate current.
1.3. Plot the V-I characteristics of SCR.

Lab 2. Fabricate the light dimmer with TRIAC.

Lab 3.

3.1. Fabricate full-wave single-phase rectifier with resistive load.
3.2. Select capacitor for reducing the ripple factor below 0.1.
3.3. Note down its output voltage waveforms with and without capacitor filter.

Lab 4.

4.1. Fabricate full-wave single-phase controlled rectifier with thyristors.
4.2. Note down its output voltage waveforms with resistive load.

Lab 5.

5.1. Fabricate dc chopper using thyristor.
5.2. Note down its output voltage waveforms with resistive load.

Lab 6.

6.1. Fabricate single-phase ac voltage controller.
6.2. Note down its output voltage waveforms with resistive load.

Lab 7.

7.1. Demonstrate the single-phase square wave inverter with resistive load.
7.2. List out the major components of inverter.

7.3. Draw the circuit diagram according to demonstration.

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	Power Electronics Devices	10	18
2	Power Rectifier	11	20
3	DC Chopper	6	10
4	Inverter	10	18
5	AC voltage controller	8	14
	Total	**45**	**80**

* There could be minor deviation in mark distribution.

References:

- A. Chakrabarti, "Fundamentals of Power Electronic and Drives" Dhanpat Rai and Co., 2002.
- A.K. Gupta and L.P. Singh, "Power Electronics and introduction to Drives", Dhanpat Rai Publishing company (P) Ltd., India 2001.

Electrical Machines II

EG3103EE

Year: III **Total: 7 hours /week**

Part: I **Lecture: 3 hours/week**

Tutorial: 1 hour/week

Practical: hours/week

Lab: 3 hours/week

Course Description:

This course covers the electrical machines-three-phase induction motor and generator, single phase ac motors, synchronous generator and synchronous motor. It deals with the constructional details, operating principle, characteristics, testing methods of the above machines.

Course Objectives:

After completion of this course, student will be able to:

1. Explain the basic constructional details of three-phase induction machine, single phase ac motor and synchronous machine,
2. Operate and characterize three-phase induction motor and generator, single phase ac motors, synchronous generator and synchronous motor, equivalent circuit of three-phase induction machine, single phase ac motors, synchronous generator and synchronous motor,
3. Test three-phase induction motor.

Course Contents:

Theory

Unit 1. Three Phase Induction Motor [15 Hrs.]

1.1. Constructional details – Yoke, stator, stator windings, and rotor – squirrel cage type and phase wound type.

1.2. Operation – Production of rotating magnetic field, operating principle, reversing the direction of rotation.

1.3. Stand still condition – equivalent circuit, starting current and starting torque.

1.4. Running condition - equivalent circuit, running current and torque.

1.5. Torque-Speed characteristics, effect of applied voltage on T-S characteristic, effect of rotor resistance on T-S characteristic.

1.6. Power stages, losses and efficiency

1.7. Starting methods – Direct On-line starting, Primary resistor method, Auto-transformer method, Star-Delta method.

1.8. Speed control – Primary voltage control method, Rotor resistance control method, frequency control method, Cascade connection method.

1.9. Induction generator – principle of operation, excitation requirement, voltage build-up process, isolated and grid connected modes of operation.

1.10. Numerical problems.

Unit 2. Single Phase AC Motors [8 Hrs.]

2.1. Split-phase induction motor – Construction, concept of pulsating field produced by single phase winding, double revolving field theory, Torque-speed characteristic, self-starting by split-phase winding, Characteristics and applications.
2.2. Capacitor start and induction run motor – Operating principle, Characteristics and applications.
2.3. Capacitor start and run motor- Operating principle, Characteristics and applications
2.4. Shaded pole motor – Operating principle, Characteristics and applications
2.5. AC series motor – Operating principle, Characteristics and applications

Unit 3. Three-phase Synchronous Generator [12 Hrs.]

3.1. Constructional details and types.
3.2. Operation – Operating principle, emf equation, armature winding parameters and its effect on emf generation, relationship between speed, frequency and number of magnetic poles in rotor, concept of geometrical degree and electrical degree.
3.3. Advantages of stationary armature winding and rotating field winding.
3.4. Loaded operation – effect of armature winding resistance, leakage reactance, armature reaction, concept of synchronous impedance, equivalent circuit and phasor diagrams for resistive, inductive and capacitive load, voltage regulation.
3.5. Synchronizing action and synchronizing power Synchronous generator connected to infinite bus, effect of excitation.
3.6. Parallel operation and synchronization.
3.7. Related numerical problems.

Unit 4. Synchronous Motor [10 Hrs.]

4.1. Principle of operation and starting method.
4.2. General features and applications.
4.3. No-load and load operation and their phasor diagrams.
4.4. Effect of excitation on armature current and power factor- V and inverted V curves.
4.5. Power-Angle characteristic of cylindrical and salient pole motor.
4.6. Hunting effect and its prevention in synchronous motor.

Practical: [45 Hrs.]

Lab 1. Perform experimental study on three-phase squirrel-cage induction motor.
1.1. Connect and start the motor with star-delta starter **[3 Hrs.]**
1.2. Measure parameters to obtain the torque-speed characteristics and load-efficiency curve for operating range (i.e. no-load to full load) **[3 Hrs.]**

Lab 2. Perform experimental study on three-phase slip ring induction motor.
2.1. Connect and start the motor with external rotor rheostat starter **[3 Hrs.]**
2.2. Measure parameters to obtain the torque-speed characteristics with and without external rotor resistance and compares the results. **[3 Hrs.]**

Lab 3. Perform experimental study on induction motor testing.
3.1. Perform no-load test **[3 Hrs.]**
3.2. Perform blocked rotor test and evaluate the equivalent circuit parameters. **[3 Hrs.]**

Lab 4. Perform experimental study on single phase ac motor.
4.1. Connect and start a split-phase motor and obtain its characteristics **[3 Hrs.]**

4.2. Connect and start a capacitor start and run motor and obtain its characteristics **[3 Hrs.]**
4.3. Compare their characteristics. **[1 Hrs.]**

Lab 5. Perform experimental study on single phase shaded pole ac motor.
5.1. Connect and start a shaded pole ac motor and obtain its characteristics. **[3 Hrs.]**

Lab 6. Perform experimental study on single phase ac series motor.
6.1. Connect and start a single-phase ac series motor and obtain its characteristics. **[3 Hrs.]**

Lab 7. Perform experimental study on synchronous generator.
7.1. Measure parameters to obtain Open Circuit Curve of a synchronous generator. **[3 Hrs.]**
7.2. Measure parameters to obtain load characteristics of a synchronous generator with resistive, inductive and capacitive loads. **[3 Hrs.]**

Lab 8. Perform experimental study on synchronization of synchronous generator.
8.1. Synchronize a three-phase synchronous generator to infinite bus. **[2 Hrs.]**
8.2. Study the effect of change in excitation. **[1 Hrs.]**

Lab 9. Perform experimental study on synchronous motor.
9.1. Connect and start a synchronous motor **[3 Hrs.]**
9.2. Study the effect of change in excitation. **[2 Hrs.]**

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	Three Phase Induction Motor	15	27
2	Single Phase AC Motors	8	14
3	Three-phase Synchronous Generator	12	21
4	Synchronous Motor	10	18
	Total	**45**	**80**

* There could be minor deviation in mark distribution.

References:

1. Nagrath I.J. and Kothari D.P., (2017) *"Electric Machines"*, (Third edition), Tata McGraw-Hill publication.
2. Gupta J.B., (2013) *"Theory and performance of Electrical Machines"* (Ninth edition), S.K. Kataria & Sons, India.

Minor Project
EG3101EEX

Year: III **Total: 4 hours /week**
Part: I **Lecture: hours/week**
Tutorial: hour/week
Practical: 4 hours/week
Lab: hours/week

Course Description:
Students are required to carry out a small practical oriented fabrication project work under the supervision of teacher. The project could be a new job or repeated job, which had been already carried out in the practical exercises of the previous courses. The project work shall be focused to develop the fabrication and testing skill.

Course Objectives:
1. The objective of the course is to be familiar with electrical/electronic system and components and build up the fabrication skills with them.

Course Contents:
Topic Selection
The project topic should be based on the course contents. Students may propose their own project and get approval from the department or student may choose a project offered by the department. The project work shall be related to:
- Electrical machines
- Power electronics
- Protection system
- Control system
- Instrumentation system
- Microcontrollers
- Digital electronics
- Software and hardware based electronic applications
- Any other topics related to electrical engineering approved by the department

Project Proposal
Students have to prepare and present the project proposal on selected topic. Proposal should contain; abstract, introduction, objectives, application, literature review, methodology, estimated budget, time frame and expected output.

Project Report and Presentation
Completion of project ends with report submission and presentation to the department. Project report should contain abstract, introduction, objectives, application, literature review, methodology, result obtained and conclusion.

Note: A group not exceeding ***six*** students shall select a project. Each project shall be supervised by a teacher from the department.

Internal Evaluation

Title	Marks
Attendance + Discipline + Punctuality	20
Proposal Defense	20
Mid Term Defense	20
Total	**60**

Final Evaluation Scheme

S.N.	Evaluation Criteria	Marks Distribution	Total Marks
1	Report Evaluation	Report Writing Format (4) Content of Report (6)	10
2	Project Evaluation	Content of Project (10) Project Demonstration (6)	16
3	Project Presentation	Presentation Skill (4) Presentation Dress-Code (2)	6
4	Viva	8	8
5	Internal Evaluation	60	60
	Total		**100**

Digital Electronics Circuit

EG3102EEX

Year: III **Total: 7 hours /week**

Part: I **Lecture: 3 hours/week**

Tutorial: 1 hour/week

Practical: 3 hours/week

Lab: hours/week

Course Description:

This course deals with fundamentals of digital electronics and switching characteristics of semiconductor junction diode, bipolar junction transistor (BJT), metal-oxide semiconductor field-effect transistor (MOSFET). It deals with basic function of timer ICs such as 555IC, building various circuits using 555ICs, behavior of different multivibrator circuits and function of Schmitt trigger.

Course Objectives:

On completion of this course the students will be enabled to:

1. Introduce about the switching behaviors semiconductor diode and transistors.
2. Generate and apply clock pulses to digital logic devices.
3. Analyze different bipolar and MOS logical circuits.
4. Explain various logic specifications.
5. Construct and operate of different volatile and non-volatile memory devices.
6. Analyze of different types of integrated logic circuit (families) and their major parameters.

Course Contents:

Theory

Unit 1. Fundamentals of Switching [7 Hrs.]

1.1. Analog Signal and Digital Signal
1.2. Electronic Switch
  1.2.1. Diode as a Switch
  1.2.2. BJT as a Switch
  1.2.3. MOSFET as a Switch
1.3. Positive and Negative Logic
1.4. Pulse Transition Detector

Unit 2. Waveform Generators [7 Hrs.]

1.1. Clock Waveforms
1.2. Timer IC 555
1.3. Schmitt Trigger
1.4. Multivibrators
  1.4.1. Astable Multivibrator
  1.4.2. Bistable Multivibrator
  1.4.3. Monostable Multivibrator
1.5. Functional diagram of IC 555
1.6. Multivibrators using Timer IC 555
1.7. Timer IC 556

Unit 3. Analysis of Logic Circuits **[7 Hrs.]**

1.1. Logic Level Diagrams
1.2. Transfer Characteristic Curve
1.3. Logic Specifications
1.4. Logic Families
1.5. Logic IC Packages

Unit 4. Logic Specifications **[7 Hrs.]**

1.1. Power Supply Levels
1.2. Power Dissipation
1.3. Operating Temperature
1.4. Propagation Delay
1.5. Noise Margin
1.6. Fan In, Fan Out

Unit 5. Logic Families **[10 Hrs.]**

1.1. Diode-Diode Logic (DDL)
1.2. Resistor-Transistor Logic (RTL)
1.3. Diode-Transistor Logic (DTL)
1.4. Transistor-Transistor Logic (TTL)
1.5. TTL Sub-families
1.6. Introduction to IIL,ECL
1.7. MOS Logic

Unit 6. Memory Devices **[7 Hrs.]**

1.1. Volatile and Non-Volatile Memories
1.2. Read Only Memory (ROM)
1.3. ROM Family
1.4. Random Access Memory (RAM)
1.5. RAM Family

Practical: **[45 Hrs.]**

1. Realize an RTL Inverter circuit.
2. Build a DDL logic gate circuit.
3. Make a modified DTL logic gate.
4. Measure power dissipation and propagation delay in TTL logic circuits
5. Compare ideal and real voltage transfer characteristic curve of CMOS Inverter
6. Construct a timer IC 555 based astable multivibrator
7. Connect a timer IC 555 based bistable multivibrator
8. Build a timer IC 555 based clock pulse generator

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	Fundamentals of Switching	7	12
2	Waveform Generators	7	12
3	Analysis of Logic Circuits	7	12

4	Logic Specifications	7	12
5	Logic Families	10	20
6	Memory Devices	7	12
	Total	**45**	**80**

* There could be minor deviation in mark distribution.

References:

1. Gupta B. R. and Singhal V., " Digital Electronics" S. K. Katariaa & Sons, 5th Edition, 2005.
2. Donald P. Leach, Albert Paul Malvino and Goutam Saha, “Digital Principles and Applications”, 6th edition, Tata McGraw-Hill, 2006
3. William H. Gothmann, “Digital Electronics, An Introduction to Theory and Practice”, 2nd edition, PHI, 2009

Repair and Maintenance of Consumer Appliances II

EG3103EEX

Year: III **Total: 4 hours /week**

Part: I **Lecture: 1 hours/week**

Tutorial: hour/week

Practical: 3 hours/week

Lab: hours/week

Course Description:

This course deals with the procedure of repair, testing, rewinding of transformers, motor starters, Armatures.

Course objectives:

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

1. Diagnose the fault of transformer and motor.
2. Dismantle, repair. Assemble and test the transformer and motor.
3. Rewind transformer coils, stator coil and armature of motors.

Course contents:

Theory

Unit 1. Repair and maintenance of induction stove and microwave oven [3 Hrs.]

1.1. Induction Stove: Introduction to induction stove and its' principle. Listing the components and draw the circuit diagram, Theory on continuity body leakage and its' important in brief.

1.2. **Microwave oven (MWO)**

1.2.1. Introduction to oven, Control panel, ON/OFF switch, thermostat –timer indicator switch, Hob (boiling plate elements. Grill plate elements.

1.2.2. Oven element – visual inspection, continuity body leakage, test, earth test, disassembling and assembling, Final test

1.2.3. Basic working principle of circuit and block description of Microwave oven, identification of parts and their working, MWO heating /cooling concept, MWO safe utensils and safety precaution, basic fault finding and solving ideas.

Unit 2. Repair and maintenance of Volt – guard and water pump [2 Hrs.]

2.1. Volt – guard: Transformer, spike suppression, electronic components, low-high cut system, relay unit, continuity of components and body leakage.

2.2. Water Pump: Principle of water pump set (3-phase and single phase), Priming of pump visual inspection of pump motor set, free rotation of rotor/pump smelling of burn out starting coil and running coil in single phase, use of capacitor, centrifugal switch, 3 phase winding Y - Δ connection, Y - Δ starter – phase sequence, continuity – body leakage test.

Unit 3. Repair and maintenance of Transformer [3 Hrs.]

3.1. Auto-Transformer: Auto- Transformer coil plug, leads, indicator ON/OFF switch, regulator brush, dial indicator, input-output, fuse, visual inspection, continuity test- body leakage test, Dis-assemble and assembling procedure

3.2. Repair and maintenance of existing transformer: Review of repair and maintenance, constructional of transformers, components of transformer, possible fault and its diagnosis idea, Test – continuity and body leakage, coil to coil leakage test

Unit 4. Repair, maintenance and rewinding of motors [4 Hrs.]

4.1. Maintenance and Repair of motors: Review of type of motor, construction and probable problem-loose parts, loose connection, broken parts, burn outs, jams. Review of No-load test and full load test

4.2. Rewinding – stator of motor: Introduction to 1-phase motor, its' types- and circuit diagram. Construction of single-phase motor and review of type of windings. Definitions of pole pitch, slot, teeth, slot insulation, connection of windings.

Practical:

1. Repair maintenance of Induction Stove [2 Hrs.]

1.1. Disassemble Induction Stove.
1.2. Test of parts-, control panel, coils, ceramic glass (if any), impedance matching circuit, tank circuit, and applicator, power connection and options (like temperature sensors), indicators by using multimeter and visual inspection.
1.3. Repair and replace (if any).
1.4. Assemble all components.
1.5. Final test.

2. Repair maintenance of Microwave oven (MWO) [4 Hrs.]

2.1. Disassemble Microwave oven (MWO).
2.2. Test of parts- Control panel, ON/OFF switch, thermostat –timer indicator switch, Hob (boiling plate elements), Grill plate, heating elements, power connection and options (like temperature sensors), indicators by using multimeter and visual inspection.
2.3. Repair and replace (if any).
2.4. Assemble all components.
2.5. Final test.

3. Repair maintenance of Volt - guard [3 Hrs.]

3.1. Disassemble Volt – guard.
3.2. Test of Parts-Transformer, spike suppression, electronic components, low-high cut system, relay unit, power connection and options (like temperature sensors), indicators by using multimeter and visual inspection.
3.3. Repair and replace (if any).
3.4. Assemble all components.
3.5. Final test.

4. Repair maintenance of Auto-Transformer [3 Hrs.]

4.1. Disassemble Auto- Transformer.
4.2. Test of parts- coil plug, leads, indicator ON/OFF switch, regulator brush, dial indicator, input-output, fuse, power connection and indicators by using multimeter and visual inspection.
4.3. Repair and replace (if any).
4.4. Assemble all components.
4.5. Final test.

5. Repair maintenance of Water Pump [3 Hrs.]

5.1. Disassemble water pump.
5.2. Test of Parts-Single phase and three phase pump set. Priming of pump, bearing (if any), starting coil and running coil, capacitor, centrifugal switch and power connection by using multimeter and visual inspection.
5.3. Repair and replace (if any).
5.4. Assemble all components.
5.5. Final test.

6. Repair and maintenance of existing transformer. [10 Hrs.]

6.1. Demonstrate repair and maintenance compliance stated in the standard procedure manual.
6.2. Refer maintenance manual and circuit diagram.
6.3. Ensure all required tools and kits are in good condition.
6.4. Check open, short circuit and body leakage test of two winding, multi winding taped winding and trace the fault.
6.5. Study the finding and consult instructor.
6.6. Dismantle the core and coils
6.7. Take data of each coil – size of wire and number of turns – compare with the enamel wire data table.
6.8. Clean and assemble (Former) Bobbin
6.9. Rewind coils of appropriate size, material, number of turns and fix tag on beginning and ends
6.10. Assemble core and coils together
6.11. Test – continuity and body leakage, coil to coil leakage test
6.12. Varnes the transformer and dry it, assemble body
6.13. Connect the proper load and run for load test.

7. Maintenance and Repair of motors [10 Hrs.]

7.1. Find out problem from customer Visual inspection for loose parts loose connection, broken parts, burn outs, jams.
7.2. Check continuity and leakage
7.3. Perform No load and full load test
7.4. Dismantle universal motor of drill machine, hand saw machine, hand grinder clean and inspect armature, field coil, commutator, bearings shape carbon brush, assemble and test run.

7.5. Dismantle single phase capacitor start induction motor, clean and inspect squirrel cage rotor, test stator windings, capacitor centrifugal switches, distinguish starting windings and running winding. Grease the bearing assembles and test run.
7.6. Dismantle a 3-phase induction motor, clear and inspect squirrel cage rotor, test state rewinding, find type of winding- change of grease bearings – Assemble and test run.

8. Rewinding – stator of motor [10 Hrs.]

8.1. Find out the type of motor- Capacitor start motor, running and starting winding, capacitor centrifugal switch.
8.2. Note down the detail of name plate – power output voltage, frequency, connection, rpm, full load, phase, number full load current insulation type, manufacture model no.
8.3. Find out no of poles: Pitch of coil – no of slots that each coil spans
8.4. Find out no of turn in each coil
  8.4.1. Size of wire in each winding
  8.4.2. Kind of connection (series- parallel)
  8.4.3. Position of windings in relation to other windings
8.5. conform the type of winding and ensure for procedure - hand, form skein
8.6. Put Slot insulation in both size and kind: Number of slots, Stripping the stator, Magnet wires (enamel wire), Slots insulation – insulation class, insulation material, size cuffed ends
8.7. Rewinding- hand rewinding, form winding, skein winding
8.8. Connect the winding – single voltage, double voltage series parallel recognizes the connection
8.9. Splice and tape the leads
8.10. Test the new winding, Bake and varnish

References:

1. Bakshi, U. A., & Bakshi, M. V. (2020). *Electrical Machines-I*. Technical Publications.
2. Bakshi, U. A. (2020). *Electrical Machines-II*. Technical Publications.
3. Gupta, J. B. (2009). *Theory & Performance Of Electrical Machines*. SK Kataria and Sons.
4. Bertoldi, P., Ricci, A. & de Almeida, A. (2001). "*Energy Efficiency in household appliances and lighting"*. Springer Science & Business Media.
5. Bhatia K.B. (2002). *Practical A.C. and D.C. Motor Winding*. Standard Publishers Distributors.
6. Rosenberg R. (1970). *Electrical Motor Repair.* Holt, Rinehart and Winston.
7. Vinogradov, N.V. (1970). *The Industrial Electrician.* Mir Publishers, Moscow.
8. Hanumanthappa, S. & Javaraiah, H. (2018), *A Guide book: PC Maintenance, Troubleshooting and Repair.* LAP LAMBERT Academic Publishing.

Communication System I

EG3104EEX

Year: III **Total: 6 hours /week**
Part: I **Lecture: 4 hours/week**
Tutorial: hour/week
Practical: 2 hours/week
Lab: hours/week

Course Description:
This course provides a basic framework for understanding the fundamental concept of communication systems. The course deals with Analog Communication and Digital Communication aspects

Course Objectives:
After completing this course, the students will be able to

1. Explain the Basic Concepts of Signals and systems
2. Describe the basics of analog and digital communication and theirs applications
3. Illustrate the principle of modulation and demodulation

Course Contents:

Theory

Unit 1. Introduction [8 Hrs.]

1.1. Analog and Digital signals and source
1.2. Electromagnetic spectrum and it's ranges
1.3. Block diagram of analog System
1.4. Modulation and it's need
1.5. Wired and Wireless channels
1.6. Noise, Distortion and Interference

Unit 2. Basic Type of Signals and Systems in Communication Systems [10 Hrs.]

2.1. Basic signals and mathematical expression
  2.1.1. Ramp Signal, Unit Step, Unit Impulse, Sine, Exponential
2.2. Classification of signals
  2.2.1. Causal and Non-Causal Signal, Deterministic and Non-Deterministic Signal Periodic and non-periodic Signal
2.3. Energy and power Signal
2.4. Systems
  2.4.1. Linear and nonlinear system, stable and unstable system,
2.5. Introduction to Fourier series
2.6. Introduction to Fourier Transform

Unit 3. Amplitude Modulation and Demodulation [12 Hrs.]

3.1. Introduction to AM
3.2. Double Sideband AM (DSB-AM), time domain expression, frequency domain expression, modulation index, signal bandwidth

3.3. DSB-AM generation: Balanced Modulator
3.4. DSB-AM Demodulation: Envelop Detection
3.5. Introduction to DSB-SC, SSB,VSM and its waveform
3.6. Super heterodyne AM Receiver

Unit 4. Frequency Modulation and Phase Modulation [8 Hrs.]

4.1. Basic Definition, time domain expression for FM and PM
4.2. Time Domain expression for single tone modulated fm Signals, B/W of Fm
4.3. Direct generation of FM
4.4. Demodulation of FM by Limiter Discriminator

Unit 5. Introduction of Digital system [5 Hrs.]

5.1. Block diagram of Digital Communication System
5.2. Sampling Theorem Definition, Nyquist Rate, Nyquist interval
5.3. Shannon Hartley Channel capacity theorem

Unit 6. Modulation Techniques [8 Hrs.]

6.1. Basics of PAM, PWM and PPM
6.2. Pulse Code Modulation: Block Diagram, Advantages of PCM, Quantization and Quantization error
6.3. Introduction to ASK, FSK, PSK

Unit 7. Transmission Media [5 Hrs.]

7.1. Guided Transmission: Twisted-Pair Cable, Co-axial Cable, Optical Fiber
7.2. Unguided Transmission: Microwave, VSAT, Satellite Communication

Unit 8. Multiplexing [4 Hrs.]

8.1. Frequency Division Multiplexing: FDM in Telephony
8.2. Time Division Multiplexing: Synchronous and Asynchronous TDM

Practical: [30 Hrs.]

1. Observe the different types of signals.
2. Observe Fourier Series and Fourier Transform
3. Illustrate Amplitude Modulation, DSB-AM, DSB-SC Modulation and Demodulation
4. Illustrate Frequency Modulation and Phase Modulation in time domain
5. Represent wave in Pulse Code Modulation
6. Illustrate Amplitude Shift Keying and Frequency Shift Keying

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	Introduction	8	11

2	Basic Type of Signals and Systems in Communication Systems	10	12
3	Amplitude Modulation and Demodulation	12	16
4	Frequency Modulation and Phase Modulation	8	11
5	Introduction of Digital system	5	7
6	Modulation Techniques	8	11
7	Transmission Media	5	7
8	Multiplexing	4	5
	Total	**60**	**80**

* There could be minor deviation in mark distribution.

References

1. B. P Lathi, "Modern digital and analog Communication system" Third edition, Oxford university press
2. S. Haykin, "An introduction to analog and digital communication system" latest edition
3. Dr. Sanjay Sharma, "Analog and Digital Communication", latest edition, S.K Kataria and Sons
4. Oppeheim, *Signals and Systems.*

Third Year/Second Part

S.N.	Course Code	Subject
1	EG3201EEX	Communication System II
2	EG3202EEX	Design, Estimating & Costing of Electrical & Electronics Installation
3	EG3203EEX	Major Project
4	EG3204EEX	Industrial Attachment
5	EG3201MG	Entrepreneurship Development
6	EG3205EEX	Basic Computer Network
7	EG3206EE	Transmission and Distribution of Electrical Power
8		Elective
	EG3206EEX.1	a) Hydro Power
	EG3206EEX.2	b) Broadcast Engineering
	EG3206EEX.3	c) Renewable Energy Technology
	EG3206EEX.4	d) Electrical Energy Management
	EG3206EEX.5	e) Internet/Intranet
	EG3206EEX.6	f) Satellite Communication

Communication System II

EG3201EEX

Year: III **Total: 5 hours /week**
Part: II **Lecture: 4 hours/week**
Tutorial: hour/week
Practical: 2/2 hours/week
Lab: hours/week

Course Description:

This course deals with review of communication system, telecommunication network, multiplexing and digital switching, optical fiber communication, satellite communication, cellular mobile communication, recent trends in communication system. This course is designed with the aims of providing knowledge in the field of analog and digital communication, telecommunication, transmission media and wireless communication.

Course Objectives:

1. Students are able to understand about basic theories related to communications.
2. Describe the fundamentals of analog and digital communication systems.
3. Explain the fundamentals of telecommunication network.
4. Explain the fundamentals of multiplexing and digital switching.
5. Introduce optical fiber, satellite and cellular mobile communications systems.
6. Define some recent trends in communication technology.

Course Contents:

Theory

Unit 1. Introduction [**7 Hrs.**]

1.1. Definition, types and properties of signals used in communication systems
1.2. Basic fundamentals of computer network
1.3. Communication system and computer network
1.4. Computer communication protocols
1.5. Application area of communication network

Unit 2. Telecommunication Network **[8 Hrs.**]

2.1. Introduction of telecommunication network
2.2. Evolution and history of telecommunication
2.3. Types of telecommunication network
2.4. Network access
2.5. Overview of ISDN, VPN, VOIP, IP switching

Unit 3. Multiplexing and Digital Switching **[9 Hrs.**]

3.1. Multiplexing and access techniques: Frequency division, Code division, Wavelength division, and Space division.
3.2. Time division multiplex, North American TDM system, The European System (T1, E1).
3.3. Space(S) Switch, Time(T) Switch, ST, TS, STS, and TST switch

Unit 4. Optical Fiber Communication **[9 Hrs.]**

4.1. Introduction to optical fiber communication

4.2. Development of fiber optics in communication
4.3. Fiber optics transmission system
4.4. Propagation modes in optical fiber
4.5. Transmission properties of optical fiber
4.6. Repeater and amplifier used in fiber communication
4.7. Advantages and disadvantages of optical fiber

Unit 5. Satellite Communication [9 Hrs.]

5.1. Introduction of satellite communication
5.2. Types of satellite communication
5.3. Block diagram of satellite communication
5.4. Orbital mechanism and Kepler's Laws
5.5. Frequency band used in satellite communication
5.6. Advantage, disadvantage and application of satellite communication

Unit 6. Cellular mobile communication [10 Hrs.]

6.1. Evolution of cellular mobile communication systems, generation of mobile networks
6.2. Cellular mobile communication concept: Frequency re-use, handoff strategy, Cell splitting, sectoring and segmentation
6.3. Cellular Mobile technologies: GSM, CDMA, UMTS, WCDMA

Unit 7. Recent trend in communications [8 Hrs.]

7.1. Artificial intelligence and machine learning
7.2. Internet of Things (IoT)
7.3. Edge and Quantum Computing
7.4. 5G network
7.5. Cyber security

Practical: [15 Hrs.]

1. Conduct a Field visit to telecommunication organizations for instance: Radio Nepal, Balambu Earth Station, Nepal Telecom, Tribhuvan International Airport. Observe the infrastructures (various components) that are required to operate, signal processing transmission and reception. Then submit report along with the operation block diagram and future enhancement of the system.

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	Introduction	7	9
2	Telecommunication Network	8	11
3	Multiplexing and Digital Switching	9	12
4	Optical Fiber Communication	9	12
5	Satellite Communication	9	12
6	Cellular mobile communication	10	13
7	Recent trend in communications	8	11
	Total	**60**	**80**

* There could be minor deviation in mark distribution.

References:

1. Haykin, Simon. Communication systems. John Wiley & Sons, 2008.
2. Haykin, Simon S. Modern wireless communications. Pearson Education India, 2011.
3. Digital Telephony, 3rd Edition by John C. Bellamy.
4. "Optical Fiber Communications Principles and Practice", Third edition by John M. Senior assisted by M. Yousif Jamro.
5. "Satellite Communications", Timothy Pratt, Charles Bostian, Jeremy Allnutt, Wiley.
6. Rappaport, Theodore S. Wireless communications: principles and practice. New Jersey: prentice hall, Second Edition, 2006.

Design, Estimating and Costing of Electrical and Electronic Installation

EG3202EEX

Year: III **Total: 5 hours /week**
Part: II **Lecture: 3 hours/week**
Tutorial: hour/week
Practical: 2 hours/week
Lab: hours/week

Course Description:
This course deals with general principles of light and power circuit design, design of illumination scheme overhead, design of electrical installation in buildings and develops skill on construction, testing of operation and fault diagnosis in electronic circuits

Course Objectives:
After completion of this course the student will be able to:

1. Design, estimate and cost electrical installation for residential, commercial and industrial buildings.
2. Describe the various types of wiring system and selection of wiring material and accessories.
3. Explain the basic functional blocks, principles of operation of electronic equipment.
4. Assist and carry out the installation and commissioning of electronic equipment.

Course Contents:

Theory

Unit 1. General Principles **[5 Hrs.]**

1.1. Estimating: estimate of quantities and cost, analysis of cost.
1.2. Familiarization of catalogues
1.3. Recording of estimate
1.4. Determination of required quantity of material
1.5. Determination of cost of material and labour
1.6. Contingencies and overhead charges
1.7. Tender form: guidelines for inviting tenders, specimen tender

Unit 2. Design of Illumination Scheme **[8 Hrs.]**

2.1. Introduction.
2.2. Terminology in illumination
2.3. Laws of illumination
2.4. Various types of light sources
2.5. Practical lighting schemes
  2.5.1. Lighting arrangement
  2.5.2. Illumination for different occupancies
  2.5.3. Selection of luminaries.
2.6. Factory lighting.
2.7. Street lighting
2.8. Methods of calculation
  2.8.1. Lumen method with some numerical problems

Unit 3. Design, estimation and costing Consideration of Electrical Installation in buildings [12 Hrs.]

3.1. Electric supply system: single phase two wire and three phase four wire system
3.2. Protection of electrical installation against overload short circuit and earth fault
3.3. Earthing: types of earthing and its applications
3.4. General requirement of electrical installation
  3.4.1. Electricity rules
  3.4.2. Testing of installation
  3.4.3. Neutral and earth wire
  3.4.4. Service connections
  3.4.5. Sub-circuits
  3.4.6. Location of outlets, control switches, MDB and SDB
3.5. Design and location of MDB and SDB
3.6. Design of lighting and power sub circuits
3.7. Guidelines for installation of fittings
3.8. Load assessment
3.9. Selection of cable size, wires and permissible voltage drop.
3.10. Design electric circuits with and with-out relays
3.11. Design and estimation for domestic and industrial wiring
3.12. Procedure and steps for domestic and industrial wiring estimation
3.13. Modern trends in electrical wiring-MCB, ELCB, RCCB
3.14. Schematic (layout) and wiring diagram

Unit 4. Electrical Energy Survey and Power Factor [12 Hrs.]

4.1. Electricity tariffs
4.2. Energy Audits
  4.2.1. Monitor, measure and record electricity consumption and demand.
  4.2.2. Instruments use for electrical energy survey e.g. ammeter, voltmeter
  4.2.3. Wattmeter, power factor meter, power analyzer and lux meter.
4.3. Power factor fundamentals
4.4. Causes of low power factor
4.5. Leading and lagging power factor and kVAr flow
4.6. Effects of low power factor and benefits of its improvement
  4.6.1. System capacity
  4.6.2. Capital cost for new system
  4.6.3. Distribution system loss
4.7. Power factor correction
  4.7.1. Individual compensation
  4.7.2. Group compensation
  4.7.3. Central compensation
  4.7.4. Synchronous condenser

Unit 5. Estimating and costing of radio receiving system [8 Hrs.]

5.1. Introduction to radio receiving system.
5.2. Types of radio receiving system (AM and FM)
5.3. TV receiver

5.4. Frequency management.
5.5. Component use in receiving system.

Practical: **[30 Hrs.]**

1. Draw the single line and connection diagrams of electric light and power circuit.
2. Design and estimate the cost of electrical installation for residential, commercial and industrial (small) buildings.
3. Design and estimate cost of radio receiving system.
   3.1 FM receiver
   3.2 AM receiver
   3.3 TV receiver

4 Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	General principles	5	9
2	Design of Illumination Scheme	8	14
3	Design, estimation and costing Consideration of Electrical Installation in buildings.	12	21
4	Electrical Energy Survey and Power Factor	12	21
5	Estimating and costing of radio receiving system	8	15
	Total	**45**	**80**

* There could be minor deviation in mark distribution.

References:

1. Foley, Electrical Wiring Fundamentals, McGraw-Hill Inc.,US
2. J.B. Gupta, A Course in Electrical Installation Estimating & Costing, S.K. Kataria & Sons
3. Roe, L.B. (1972). *Practices and Procedure of Industrial Electrical Design*. McGraw-Hill.
4. Gupta, P.V., Dhanpat Rai
5. Pratap, H., Art and Science of Utilization of Electrical Energy Dhanpat Rai & Co. (Pvt.) Ltd.
6. Hand Book of Electrical Engineering - S.L. Bhatia
7. Bhatia, S.L., Hand Book of Electrical Engineering, Khanna Publishers
8. Grob, B. and E. Herndon, Charles, Basic Television and Video Systems, McGraw-Hill

Major Project
EG3203EEX

Year: III **Total: 6 hours /week**
Part: II **Lecture: hours/week**
Tutorial: hour/week
Practical: 6 hours/week
Lab: hours/week

Course Description:
Students are required to take up a project work related to the topic described in the course content. Students shall submit a formal project report and give a presentation at the end of semester.

Course Objective:
After completion of this project the student will be able to:
- Develop the self-capability of students to design, analyze, fabricate and testing of electrical/electronic system and devices.

Course contents:
Topic Selection
The project topic should be based on the course contents. Students may propose their own project and get approval from the department or student may choose a project offered by the department. The project work shall be related to:
- Electrical machines
- Power electronics
- Protection system
- Control system
- Instrumentation system
- Microcontroller
- Digital electronics
- Hardware/ Software based electronic applications
- Any other topics related to electrical engineering approved by the department

Project Proposal
Students have to prepare and present the project proposal on selected topic. Proposal should contain; abstract, introduction, objectives, application, literature review, methodology, estimated budget, time frame and expected output.

Project Report and Presentation
Completion of project ends with report submission and presentation to the department. Project report should contain abstract, introduction, objectives, application, literature review, methodology, result obtained and conclusion.

Note: A group not exceeding ***four*** students shall select a project. Each project shall be supervised by a teacher from the department.

Internal Evaluation Scheme

Title	Marks
Attendance+Discipline+Puntuality	20
Proposal Defense	20
Mid Term Defense	20
Hardware/Software Interfacing/Assembling and Organization	30
Total	**90**

Final Evaluation Scheme

S.N.	Evaluation Criteria	Marks Distribution	Total Marks
1	Report Evaluation	Report Writing Format (8)	16
		Content of Report (8)	
2	Project Evaluation	Content of Project (14)	20
		Project Demonstration (6)	
3	Project Presentation	Presentation Skill (4)	12
		Presentation Dress-Code (4)	
4	Viva by External	12	12
5	Internal evaluation	90	90
	Total		**150**

Industrial Attachment

EG3204EEX

Year: III **Total: 4 hours /week**

Part: II **Lecture: hours/week**

Tutorial: hour/week

Practical: 4 hours/week

Lab: hours/week

Course Description:

The course deals with the practical approach on real industry/ plant where the students are aimed to learn the real industrial set-up develop skills; understand organization culture, working environment and organization behavior.

Course Objectives:

The main objective of this attachment is to:

1. Familiarize with real industrial system
2. Boost up practical knowledge of existing technology
3. Develop skill-oriented knowledge, organizational behavior, organization structure and develop professionalism within the students.

General procedure:

The students shall be deputed to various electrical power station/sub-station, motor design and maintenance workshop, transformer manufacturing industry and maintenance workshop, electrical/ electronic components manufacturing industry and maintenance workshop, electronic maintenance labs, Television Broadcasting, Radio Broadcasting, Telecommunication, ISPs, and Fiber cable related industries, Networking Equipment and Peripherals installation and maintenance companies and other relevant industries on a full time basis for duration of 60 Hrs**.**.

The department should assign the faculty members for a group of students. Students should be evaluated at the end of attachment.

Industrial attachment shall consist of learning skill aspect and methods in design operation, diagnosis, maintenance and repair of machines and equipment used in respective field. For the first two days the students shall observe the operation of industry or plant. During the next remaining time he/she shall work as operator/supervisor/mechanist. They will be assigned to perform available work in the industry supervised by the assigned engineer/technician from the industries. Students should collect information related to the assigned task and involve in regular activities of the enterprises assigned to them and at the same time he/she shall be engaged in preparing the report and presentation.

After the completion of their attachment each group has to submit the report and give presentation to the college department. The report should be in standardized format provided by the department and should include technical as well as managerial part of the industries along with daily diary.

The report should consist of the following information:

1. Profile of the industry/plant/workshop and layout diagram of respective industry.
2. Organizational structure and administrative set-up of industry or plant

3. Daily dairy maintenance
4. Basic feature of industry or plant
5. Brief description of technological aspect of the respective industry.
6. Suggestions for improvement.

Evaluation Scheme:
The final evaluation scheme will be indicated in the table below:

Internal Evaluation:

Title	Marks
Attendance + Discipline+ Punctuality	20
Daily Workbook Submission	20
Class work Activities	20
Total	**60**

Final Evaluation:

Title	Marks
Evaluation by supervisor from enterprises	20
Evaluation of written report by department	12
Presentation	8
Internal Evaluation	60
Total	**100**

Entrepreneurship Development
EG 3201 MG

Year: III **Total: 5 Hrs. /week**
Semester: II **Lecture: 3 Hrs./week**
Tutorial: Hr./week
Practical: 2 Hrs./week
Lab: Hrs./week

Course Description:
This course is designed to provide the knowledge and skills on formulating business plan and managing small business. The entire course deals with assessing, acquiring, and developing entrepreneurial attitude; skills and tools that are necessary to start and run a small enterprise.

Course Objectives:
After completion of this course students will be able to:
1. Understand the concept of business and entrepreneurship;
2. Explore entrepreneurial competencies;
3. Analyze business ideas and viability;
4. Learn to formulate business plan with its integral components and
5. Manage small business.

Course Contents:

Theory

Unit 1: Introduction to Business & Entrepreneurship: [9 Hrs.]
- 1.1 Overview of entrepreneur and entrepreneurship
- 1.2 Wage employment, self- employment and business
- 1.3 Synopsis of types and forms of enterprises
- 1.4 Attitudes, characteristics & skills required to be an entrepreneur
- 1.5 Myths about entrepreneurs
- 1.6 Overview of MSMEs (Micro, Small and Medium Enterprises) in Nepal

Unit 2: Exploring and Developing Entrepreneurial Competencies: [9 Hrs.]
- 2.1 Assessing individual entrepreneurial inclination
- 2.2 Assessment of decision-making attitudes
- 2.3 Risk taking behavior and risk minimization
- 2.4 Creativity and innovation in business
- 2.5 Enterprise management competencies

Unit 3: Business identification and Selection: [4 Hrs.]
- 3.1 Sources and method of finding business idea(s)
- 3.2 Selection of viable business ideas
- 3.3 Legal provisions for MSMEs in Nepal

Unit 4: Business plan Formulation: **[18 Hrs.]**

4.1 Needs and importance of business plan

4.2 Marketing plan

- Description of product or service
- Targeted market and customers
- Location of business establishment
- Estimation of market demand
- Competitors analysis
- Estimation of market share
- Measures for business promotion

4.3 Business operation plan

- Process of product or service creation
- Required fix assets
- Level of capacity utilization
- Depreciation & amortization
- Estimation office overhead and utilities

4.4 Organizational and human resource plan

- Legal status of business
- Management structure
- Required human resource and cost
- Roles and responsibility of staff

4.5 Financial plan

- Working capital estimation
- Pre-operating expenses
- Source of investment and financial costs
- Per unit cost of service or product
- Unit price and profit/loss estimation of first year

4.6 Business plan appraisal

- Return on investment
- Breakeven analysis
- Risk factors

Unit 5: Small Business Management: **[5 Hrs.]**

5.1 Concept of small business management

5.2 Market and marketing mix

5.3 Basic account keeping

Practical

Unit 1: Overview of Business & Entrepreneurship [2 Hrs.]

1. Collect business information through interaction with successful entrepreneur

Unit 2: Exploring and Developing Entrepreneurial Competencies [2 Hrs.]

- Generate innovative business ideas

Unit 3: Product or service Identification and Selection [2 Hrs.]

1. Analyze business ideas using SWOT method

Unit 4: Business Plan Formulation [22 Hrs.]

1. Prepare marketing plan
2. Prepare operation plan
3. Prepare organizational and human resource plan
4. Prepare financial plan
5. Appraise business plan
6. Prepare action plan for business startup

Unit 5: Small Business Management [2 Hrs.]

1. Prepare receipt and payment account
2. Perform costing and pricing of product and service

Basic Computer Network

EG3205EEX

Year: III **Total: 6 hours /week**

Part: II **Lecture: 3 hours/week**

Tutorial: 1 hour/week

Practical: hours/week

Lab: 2 hours/week

Course Description:

This course deals with fundamentals of computer network, its architecture, its standards and protocols used in computer network.

Course Objectives:

After completing this course, the students will be able to:

1. Explain the architecture of computer network
2. Identify hardware devices and software used in computer networks
3. Setup small home/office networks

Course Contents:

Theory

Unit 1. Introduction to computer network [2 Hrs.]

1.1. Introduction, definition, features, issues
1.2. Applications of computer networks
1.3. Advantages and disadvantages of computer networks

Unit 2. Network architecture [8 Hrs.]

2.1. Network topologies: Bus, Ring, Mesh, Star
2.2. Network types: LAN, MAN, WAN, PAN, Extra-net, Intra-net, Inter-net
2.3. Layered network architecture, protocols, interfaces, services
2.4. OSI Reference model
  2.4.1. Physical Layer
  2.4.2. Data Layer
  2.4.3. Network Layer
  2.4.4. Transport Layer
  2.4.5. Session Layer
  2.4.6. Presentation Layer
  2.4.7. Application Layer
  2.4.8. Device and Protocols on each Layer
2.5. TCP/IP Reference model
  2.5.1. Host-to- Network Layer
  2.5.2. Internet Layer
  2.5.3. Transport Layer
  2.5.4. Application Layer
2.6. Comparison of OSI and TCP/IP model

Unit 3. Network hardware and software [3 Hrs.]

3.1. Network workstation and server: hardware and software requirements
3.2. Client server and peer-to-peer model

3.3. Network devices: Repeater, Hub, NIC, Bridge, Switch, Router, Gateway

Unit 4. Physical layer [3 Hrs.]

4.1. Channel bandwidth and throughput; propagation time, transmission time
4.2. Transmission media
4.3. Guided: coaxial, twisted-pair (UTP, STP), fiber-optic
4.4. Unguided: radio, microwaves, infrared, Satellite

Unit 5. Data link layer [4 Hrs.]

5.1. Introduction to data link layer and its issues
5.2. Framing
5.3. Flow control at data link layer
5.4. Data link layer protocols: HDLC, PPP

Unit 6. LAN architecture/standards [4 Hrs.]

6.1. Introduction to LAN standards and architecture
6.2. Introduction to Media access control, MAC address
6.3. Introduction to wireless LAN, Bluetooth, Wi-Fi, Wi-Max

Unit 7. Network Layer [8 Hrs.]

7.1. Internetworking
7.2. Switching: Circuit switching and packet switching
7.3. Addressing issues at network layer
7.4. IP address; Different classes; Private and Public address
7.5. Subnet mask and Subnetting; Classless addressing; Network address translation (NAT)
7.6. Routing and its necessity; static and dynamic routing: RIP, IGRP, OSPF
7.7. Introduction to IPv6 and its necessity

Unit 8. Transport layer [4 Hrs.]

8.1. Transport layer issues: Congestion control, Flow control, Quality of service
8.2. Transport layer addressing, sockets, Port
8.3. Segmentation and reassembly
8.4. Connection oriented and connectionless service
8.5. TCP, UDP

Unit 9. Application Layer [5 Hrs.]

9.1. Application layer and its function
9.2. Electronic mail: SMTP, POP3, IMAP
9.3. File Transfer: FTP
9.4. Dynamic host configuration protocol (DHCP)
9.5. Introduction to DNS, HTTP, HTTPS, WWW

Unit 10. Network security [4 Hrs.]

10.1. Properties of Secure Communication
10.2. Data Encryption and Decryption
10.3. Firewalls
10.4. Virtual private network

Practical: **[30 Hrs.]**

In practical, students should be able to set up small networks. Also, they should be able to configure network hardware and network software. Following lab exercises may be helpful.

1. Install network interface card and various network devices like hub, switch, router etc.
2. Construct straight-through and cross-over cable and LAN Setup.
3. Configure Router Basic Configuration
4. Configure Static and Dynamic Routing
5. Create VLAN
6. Create Router access-list configuration
7. Perform File sharing using Network setup
8. Setup Web Server, DNS Server, DHCP Server
9. Case study: Organizational visit to study existing network system

Final written exam evaluation scheme			
Unit	**Title**	**Hrs.**	**Marks Distribution***
1	Introduction to Computer Network	2	4
2	Network Architecture	8	14
3	Network Hardware and Software	3	5
4	Physical Layer	3	5
5	Data Link Layer	4	7
6	LAN Architecture Standards	4	7
7	Network Layer	8	14
8	Transport Layer	4	7
9	Application Layer	5	10
10	Network Security	4	7
	Total	**45**	**80**

* There may be minor deviation in marks distribution.

References:

1. Andrew S. Tanebaum, David J. Wetherall, Computer Networks, 5th Edition, Prentice Hall India
2. James F. Kurose, Keith W. Ross, Computer Networking – Top Down Approach, 4th Edition, Pearson Education
3. Sanjay Sharma, A text book of Computer Networks
4. Behrouz A. Forouzan, “Data Communications and Networking”.
5. Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, 3rd Edition, Morgan Kaufmann Publishers

Transmission and Distribution of Electrical Power

EG3206EE

Year: III **Total: 4 hours /week**
Part: II **Lecture: 3 hours/week**
Tutorial: 1 hour/week
Practical: hours/week
Lab: hours/week

Course Description:
The course deals with the transmission and distribution of electrical power & energy.

Course Objectives:
After completing this course, the students will be able to:

1. Describe the transmission and distribution operation and its components
2. Explain the characteristics of interconnected power system
3. Explain voltage control and compensation techniques

Course Contents:

Theory

Unit 1. Transmission and distribution system [4 Hrs.]

1.1. Introduction and Necessity
1.2. Role of Transmission and distribution as the components of power system
1.3. Typical AC transmission system, standard voltage levels
1.4. Distinction between transmission and distribution system

Unit 2. Transmission line components [11 Hrs.]

2.1. Components of overhead transmission lines
  2.1.1. Conductors: material, stranding and bundling of conductor
  2.1.2. Supports: various types of poles and tower as supporting structure
  2.1.3. Insulators their types and applications
  2.1.4. Other components like; jumper, anti-climbing devices, danger plate, and stay wires etc.
2.2. Mechanical and electrical considerations
  2.2.1. Conductor spacing and clearance criterion
  2.2.2. Sag tension computation and related numerical problems
  2.2.3. Vibrations and Danpers
2.3. Corona effect in transmission

Unit 3. Transmission line performance [13 Hrs.]

3.1. Transmission Line parameters: Basic concept of Resistance, inductance and capacitance calculation
3.2. Skin and proximity effect
3.3. Concept of single line diagram
3.4. Classification of transmission line: Short, medium and long TLs
  3.4.1. Short TL: Sending and receiving end voltage, equivalent single line diagram, efficiency, phasor diagram and realted numerical problems

3.4.2. Medium TL: Sending and receiving end voltage, equivalent single linediagram (T-pi), efficiency, phasor diagram and realted numerical problems
3.4.3. Long TL: Introduction (only)
3.5. Ferranti effect

Unit 4. Distribution system [8 Hrs.]
4.1. Primary and secondary distribution
4.2. Radial, loop and ring main feeders
4.3. Guidelines for rural and urban distribution
4.4. Single phase and three phase distribution
4.5. Right-of-way
4.6. Underground cables for distribution
4.6.1. Seathing and armoring
4.6.2. Cable breakdown
4.6.3. Effect of moisture and temperature
1.7 Comparison between Overhead line and underground cable

Unit 5. Voltage Control [6 Hrs.]
5.1. Necessity of voltage control, voltage fluctuation and associated problems
5.2. Method for voltage control
5.2.1. Excitation control of alternator
5.2.2. Tap changing transformer
5.2.3. Synchronous condenser
5.2.4. Static compensating devices

Unit 6. Interconnected system [3 Hrs.]
6.1. Introduction, advantages and disadvantages
6.2. Effects on voltage and frequency fluctuation with interconnected system
6.3. Flexibility in real and reactive power dispatching

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	Transmission and distribution system	4	7
2	Transmission line components	11	20
3	Transmission line performance	12	21
4	Distribution system	8	14
5	Voltage Control	6	11
6	Interconnected system	4	7
	Total	**45**	**80**

* There could be minor deviation in mark distribution.

References:

- V. K. Mehta, Rohit Mehta, (2005), "Principles of Power System", S. Chand.
- Dr. B.R. Gupta, (2005), "Power System Analysis and Design".

- J.B. Gupta, (2013), “Transmission and Distribution of Electrical Power”, S. K. Kataria and sons.
- M.L. Soni, P.V. Gupta, U.S. Bhatnagar & A. Chakrabarti, (2011), “A text Book on Power System Engineering”, Dhanpat Rai & Co., India
- A.S. Pabla, (2010), “Electric Power Distribution”, Tata McGraw-Hill Publishing Company Ltd, India
- J.J. Burke, (2014) “Power Distribution Engineering Fundamentals & Applications”, Marcel Dekker, Inc., New York.

Hydropower
(Elective)
EG3206EEX.1

Year: III **Total: 5 hours /week**
Part: II **Lecture: 4 hours/week**
Tutorial: hour/week
Practical: 2/2 hours/week
Lab: hours/week

Course Description:
This course familiarizes the students of diploma level with the basics of hydropower project and major design criteria so that they would more effectively take part for implementation work of such project.

Course Objectives:
After completion of the course the students are able to

1. Describe the Basics of Hydropower Generation
2. Search for different possible layout options for a hydropower potential area
3. Explain major Components of Hydroelectric power plant
4. Apply Basic Design Principle and criteria
5. Draw the typical layout arrangement
6. Carry out the implementation work as per design for the recommended various electrical components of a particular project

Course Contents:

Theory

Unit 1. Introduction [9 Hrs.]

1.1. Energy and its sources, Present Scenario of Energy Consumption in Nepal.
1.2. Hydro-power Potential in Nepal, Gross, technical and economic potentials.
1.3. Challenges of Hydropower Development in Nepal.

Unit 2. Hydrology and Project environment [12 Hrs.]

2.1. Method of Discharge Measurement
2.2. Calculation of River Discharge: Velocity area method, salt dilution method, floats method. 2.3 Hydrograph and Flow duration curve (FDC).
2.3. Determination of Design Discharge
2.4. Advantages of hydropower and socio-environmental aspects

Unit 3. Hydroelectric Power Plant [12 Hrs.]

3.1. Working principles
3.2. Major components of Hydroelectric power plant and its layout
3.3. Classification, advantages/disadvantages of Hydroelectric power plant
3.4. Selection of Site of Hydropower plant
3.5. Concept of Gross Head & Net head
3.6. Power output equation of hydropower
3.7. Installed capacity, Firm power, secondary power, Energy generation, Dry energy, wet energy, Capacity factor

3.8. Number of Units in Hydropower project

Unit 4. Water Turbine and Governing System [12 Hrs.]

4.1. Classification of water turbine: Pelton, Francis, Cross flow, Propeller/Kaplan
4.2. Turbine selection criteria, according to head, specific speed and efficiency curves
4.3. Purpose and Working Principle of Governors

Unit 5. Electrical Design Considerations in Hydropower Project [15 Hrs.]

5.1. Selection of Generator
5.2. Excitation system: brushless and static excitation system
5.3. Transformer's selection: Numbers and Ratings
5.4. Suitable type and ratings of circuit breaker at different voltage level
5.5. Concept of protection scheme for generator and transformer
5.6. Auxiliary Power Supply system in hydropower station
5.7. Busbar types: Radial, Main and Transfer, Ring system
5.8. Earthing in Power station

Practical: 15 Hrs.

1. Conduct a Study Visit to a Hydropower station: **[10 Hrs.]**
   1.1. list out and describe major components of the project,
   1.2. identify/find out sizes/ratings and purposes of electromechanical components
   1.3. Prepare a field study report and present
2. Complete the project work. (Project data (head, discharge and so on) is given to the students) **[5 Hrs.]**
   2.1. Determine installed capacity,
   2.2. Choose appropriate numbers of units
   2.3. Recommend major electro-mechanical equipment e.g. turbine, generator, transformers and so on and
   2.4. Draw a single line layout of electrical system from water to wire

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	Introduction	9	12
2	Hydrology and Project environment	12	16
3	Hydroelectric Power Plant	12	16
4	Water Turbine and Governing System	12	16
5	Electrical Design Considerations in Hydropower Project	15	20
	Total	**60**	**80**

* There could be minor deviation in mark distribution.

References:

1. US Army Corps of Engineers. ENGINEER MANUAL- Hydroelectric Power Plants Electrical Design, 1994.
2. A text book of Power Plant Engineering, PC Sharma, SK Katria and Sons (first publication 1973, revised edition 2013)
3. Installation and commission manual for Micro Hydro power plant by ICIMOD Kathmandu 1999.

Broadcast Engineering
(Elective)
EG3206EEX.2

Year: III **Total: 5 hours /week**
Part: II **Lecture: 4 hours/week**
Tutorial: hour/week
Practical: 2/2 hours/week
Lab: hours/week

Course Description:
This course is designed to provide fundamental concepts of broadcasting such as AM, FM and Television system, audio amplifiers, CCTV and studio acoustics.

Course Objectives:
After completion of this course students will be able to:
1. Identify and analyze the broadcast communications systems concepts, elements and applications.
2. Make students familiar with the applications in different areas of broadcasting such as television, AM, FM, cable television, telecommunications, data communications, studio acoustics etc. through experiments and field researches
3. Differentiate the different broadcasting techniques such as AM, FM and TV.
4. Study and understand the basic concepts of broadcasting and obtain the knowledge of designing a simple AM/FM transmitter

Course Contents:

Theory

Unit 1. Audio signal and Audio Principles [5 Hrs.]
- 1.1. Audio signal and audio signal generation
- 1.2. Noise in audio signal, noise reduction methods: Dolby sound
- 1.3. Stereo sound, multi-dimensional sound
- 1.4. Audio Amplifier: simple concept of audio amplifier, low power amplifier simple circuit and working principle
- 1.5. Microphone: definition, basic features and its types working principle, specification, features
- 1.6. Speaker: definition, types: moving coil speaker, crystal microphone-schematic diagram, working principle, specification, feature
- 1.7. Audio data rate reduction systems for recording and transport of audio signals including an overview of psychoacoustic techniques

Unit 2. Fundamental of digital audio [5 Hrs.]
- 2.1. Concept of digitization, audio ADC, DAC
- 2.2. Popular digital audio formats: MP-1, MP-3 and DVD
- 2.3. Audio digital recording systems-magnetic, optical, semiconductor-modern USB memory.

Unit 3. Fundamental of AM Radio [12 Hrs.]
- 3.1. Modulation –definition, requirement
- 3.2. AM modulation-concept, simple circuit diagram and working principle, application

3.3. Percentage of modulation, bandwidth, channels, types of AM modulation: double side band, SSB, AM demodulation
3.4. AM radio receiver: Super heterodyne process, basic block diagram and its working principle
3.5. AM radio broadcasting system- basic block diagram and working principle

Unit 4. Fundamental of FM Radio [12 Hrs.]

4.1. FM modulation: concept, advantages over AM modulation, simple circuit diagram and working principle, modulation index, application
4.2. FM demodulation: double side discriminator, single side discriminator, ratio FM detector, FM broadcasting-Block diagram and working principle.
4.3. FM radio receiver: block diagram & working principle,
4.4. Principle of Digital radio broadcasting and receiving system
4.5. Principle of Sound mixer, sound effect and sound editing

Unit 5. Television System and Broadcasting [14Hrs.]

5.1. Introduction: scanning system- scanning, interlaced scanning, aspect ratio, resolution
5.2. Basic monochrome TV system: basic block diagram and working principle
5.3. VSB Modulation Diagram: Spectrum Analysis
5.4. Basic COLOUR TV systems-PAL, SECAM, NTSC
5.5. MONITORS: CRT, LCD, LED
5.6. DIGITAL Video Formats-MP-2, MP-4, DVD
5.7. Digital TV, HD TV, SMART 4K TV
5.8. Cable TV, internet TV, Dish-Home TV
5.9. Antenna: Basic antenna action, types of Antenna: Yagi-Uda, Parabolic, Log periodic Antenna
5.10. TV broadcasting system: basic block diagram and working principle, features
5.11. Big size TV screen, curved big screen
5.12. Video recorders-analog, digital, feature format, resolutions

Unit 6. CCTV, IP-CCTV system, features and application [6Hrs.]

6.1. CCTV: Definition, application, advantages
6.2. Analog and digital CCTV, multi TV camera CCTV system
6.3. CCTV-power distribution, DVR-NVR CCTV system
6.4. Single IP camera with Wi-Fi, tracking, PIR sensor, alarm, dual sound, USB MEMORY, microphone IP camera features and application. GPS signal levels

Unit 7. Satellite Navigation and Global Positioning System [6Hrs.]

7.1. Radio and Satellite navigation
7.2. GPS position location principles
7.3. GPS receivers and Codes
7.4. Satellite signal acquisition
7.5. GPS navigation message
7.6. GPS signal levels
7.7. Timing accuracy

7.8. GPS receiver operation

Practical: **[15 Hrs.]**

1. Field visit to broadcasting stations (Radio Nepal, Nepal Television and different FM station), VSAT station and observe the recording, transmitting, on air program telecasting etc. Prepare a report and present in group or individual in class.

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	Audio signal and Audio Principles	5	7
2	Fundamental of digital audio	5	7
3	Fundamental of AM Radio	12	16
4	Fundamental of FM Radio	12	16
5	Television System and Broadcasting	14	18
6	CCTV, IP-CCTV system, features and application	6	8
7	Satellite Navigation and Global Positioning System	6	8
	Total	**60**	**80**

* There could be minor deviation in mark distribution.

References:

1. Roy Blake, “Comprehensive Electronic Communication”, West Publishing Co.
2. B. Grob and Charles E. Herndon, “Basic Television and Video Systems”, McGraw-Hill.
3. RG Gupta, “Audio video system”.
4. Bali and Bali, “Audio video system”
5. Ajay Sharma, “Audio video TV Engineering”
6. M. L. Anand, “Fundamental of audio video system”
7. R. R. Gulati, “Monochrome and Colour TV”

Renewable Energy Technology
(Elective)
EG3206EEX.3

Year: III **Total: 5 hours /week**
Part: II **Lecture: 4 hours/week**
Tutorial: hour/week
Practical: 2/2 hours/week
Lab: hours/week

Course Description:
This course deals with fundamentals of different renewable energy resources and their role in sustainable development.

Course Objectives:
After completing this course, the students will be able to:
1. Introduce renewable energy.
2. Identify the different renewable energy resources and their importance.
3. Differentiate renewable versus Non-renewable Energy.
4. Explain the basic principles behind renewable energy sources like hydro, solar, wind and biomass.
5. Compare the prospects of renewable energy resources

Course Contents:

Theory

Unit 1. Renewable Energy **[9 Hrs.]**
- 1.1. Introduction
- 1.2. Energy resources in the World
- 1.3. Energy status in Nepal
- 1.4. Renewable versus Non-renewable Energy
- 1.5. Renewable energy resources
  - 1.5.1. Solar energy
  - 1.5.2. Hydro electricity
  - 1.5.3. Biomass
  - 1.5.4. Wind energy
  - 1.5.5. Geothermal energy
  - 1.5.6. Tidal energy
  - 1.5.7. Wave energy

Unit 2. Solar Energy **[15 Hrs.]**
- 2.1. Solar radiation
  - 2.1.1. Electromagnetic spectrum
  - 2.1.2. Prediction of solar radiation
- 2.2. Solar thermal energy
  - 2.2.1. Domestic hot water system
  - 2.2.2. Solar dryer
  - 2.2.3. Solar distillation
  - 2.2.4. Solar ponds
  - 2.2.5. Swimming pool heating

2.2.6. Concentrating collectors
2.2.7. Flat plate collectors

2.3. Solar-electricity
2.3.1. Fundamental principle of photovoltaic conversion
2.3.2. Types of photovoltaic cells (mono-crystalline, poly-crystalline, thin film or amorphous cells)
2.3.3. Solar module, energy storage battery, charge controller
2.3.4. Solar home system and solar water pumping

2.4. Battery Management System

2.5. Related Numerical (On Combination of Batteries)

Unit 3. Hydro-electricity [10 Hrs.]

3.1. Water head, flow and power from water

3.2. Types of hydropower plants
3.2.1. Large hydro, medium hydro, small hydro, micro hydro, peltry set

3.3. Micro-hydro power basics

3.4. Related Numerical (On calculating Power Output of Micro hydro)

Unit 4. Biomass [10 Hrs.]

4.1. Biomass as a fuel
4.1.1. Direct combustion
4.1.2. Gasification
4.1.3. Pyrolysis
4.1.4. Anaerobic digestion – Biogas

4.2. Role of biogas in Nepal

4.3. Components of Biogas system
4.3.1. Biogas constituents
4.3.2. Bio-digester
4.3.3. Biogas inputs (feeds)
4.3.4. Digestion
4.3.5. Slurry
4.3.6. Use of Biogas (cooking, lighting etc.)

Unit 5. Wind Energy [10 Hrs.]

5.1. Power from the winds

5.2. Wind turbines
5.2.1. Horizontal axis turbines
5.2.2. Vertical axis turbines

5.3. Electricity generation from wind turbines

5.4. Wind farm

5.5. Related Numerical (On Power output of a wind turbine)

Unit 6. Hybrid [6 Hrs.]

6.1. Introduction

6.2. Advantages of Hybrid Energy

6.3. Wind Solar Hybrid System

Practical: [15 Hrs.]

1. Measure solar radiation

2. Install Solar Home System: Solar cells and connection, charge controller and storage Battery
3. Install solar heaters, solar ovens, solar dryers
4. Operate Micro-hydro systems/ peltric set with electronic load controller
5. Demonstrate Biogas system
6. Install wind turbine, induction generator and generation controller

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	Renewable Energy	9	12
2	Solar Energy	15	20
3	Hydro-electricity	10	13
4	Biomass	10	13
5	Wind Energy	10	13
6	Hybrid	6	9
	Total	**60**	**80**

* There could be minor deviation in mark distribution.

References:

1. Godfrey, Boyle, (2012). Renewable Energy, Power for a sustainable future. Oxford University Press.
2. Kenneth, Okedu, Ahmed,Tahour &Abdel, Aissaou (2020). Wind Solar Hybrid Renewable Energy System

Electrical Energy Management
(Elective)
EG3206EEX.4

Year: III **Total: 5 hours /week**
Part: II **Lecture: 4 hours/week**
Tutorial: hour/week
Practical: 2/2 hours/week
Lab: hours/week

Course Description:
This course deals with conservation of energy in electric motor, lighting system and process equipment.

Course Objectives:
After completion of this course the student will be able to:
1. Design and conduct the energy conservation program.
2. Explain the Power factor correction.
3. Explain lighting system.
4. Explain operation of process equipment.

Course Contents:

Theory

Unit 1. Energy Status of Nepal [3 Hrs.]
- 1.1. The growth of consumption.
- 1.2. The cost of new power plant
- 1.3. Electricity Price
- 1.4. Electrical energy conservation: The national prospective

Unit 2. Plant Electrical Distribution System [12 Hrs.]
- 2.1. Typical system bus design:
  - 2.1.1. Simple radial single bus system
  - 2.1.2. Double bus system
  - 2.1.3. Sectionalized and special bus system
- 2.2. Voltage Levels
  - 2.2.1. Transformer selection
  - 2.2.2. Wiring System
- 2.3. Conductor Size
  - 2.3.1. Energy losses in conductor
  - 2.3.2. Optimum conductor size
- 2.4. Design of new plant distribution system

Unit 3. Load Management [12 Hrs.]
- 3.1. Maximum demand
  - 3.1.1. Measurement of maximum demand
  - 3.1.2. Demand charge
  - 3.1.3. Cost saving from demand control
- 3.2. Analysis of potential for demand control

3.2.1. Load factor
3.2.2. Load curve or demand profile
3.2.3. Identification of load

3.3. Methods of demand control
3.3.1. Manual demand control (load shedding and monitoring)
3.3.2. Introduction to demand Response

Unit 4. Electric Motors [10 Hrs.]

4.1. Motor efficiency and motor losses
4.2. Motor losses: stator and rotor losses, iron or magnetic core losses, friction and wind age losses, stray load losses.
4.3. Standard motor efficiencies.
4.4. Factor affecting electric motor efficiency
4.4.1. Motor size
4.4.2. Motor load
4.4.3. Motor selection and sizing
4.4.4. Motor maintenance
4.4.5. Motor rewinding

Unit 5. Lighting [11 Hrs.]

5.1. Efficiency Comparison of Lighting sources
5.1.1. Incandescent lamp
5.1.2. Fluorescent lamp
5.1.3. High intensity discharge lamp
5.1.4. Mercury vapour lamp
5.1.5. Metal halide lamp (metal arc lamp)
5.1.6. High/low pressure sodium vapor lamp
5.2. Ballasts
5.3. Energy conservation opportunities in lighting system
5.4. Turns off lights (time clocks and photo cells)
5.5. Lux level optimization
5.6. Use daylight to reduce artificial light
5.7. Lighting Retrofit Economics
5.8. Clean and maintenance of lamp
5.9. Use light control equipment, reflector, electronic ballasts, occupancy sensor

Unit 6. Process Equipment [12 Hrs.]

6.1. Role of sensors and automation in energy saving
6.2. Energy saving in process equipment
6.2.1. Turn off idle equipment
6.2.2. Operate equipment at design loading
6.3. Compressor
6.3.1. Minimize flow rate of compressed air
6.3.2. Minimum operating pressure of compressor air system
6.4. Pumps
6.4.1. Reducing friction losses

6.4.2. Reducing the flow

6.5. Adjustable speed systems

6.5.1. Mechanical system: pulley system, fluid drives, gear drives and other mechanical adjustable speed systems

6.5.2. Electrical and electronic system: multi-speed motors, pole amplitude modulated motors, electronic adjustable speed drives, energy saving by adjustable speed drive.

Practical: **[15 Hrs.]**

1. Conduct the industry visit and note down the rating of power plant equipment, total energy consumed in a month, electrical wiring distribution system, illumination level, maintenance schedule and types of motor
2. Draw a single line diagram of electric distribution system for any one of visited plant
3. Perform a case study of energy conservation by load management
4. Perform a case study of energy conservation by power factor improvement
5. Perform a case study of energy conservation in electric motor.
6. Perform a case study of energy conservation in lighting system

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	Energy Status of Nepal	3	4
2	Plant Electrical Distribution System	12	16
3	Load Management	12	16
4	Electric Motors	10	14
5	Lighting	11	14
6	Process Equipment	12	16
	Total	**60**	**80**

* There could be minor deviation in mark distribution.

References:

1. Gupta, J. B. (2012). Utilization of Electric Power and Electric Traction: For Engineering Students. Katson Books.
2. Singh, T. (2002). Installation, Commissioning and Maintenance of Electrical Equipment. SK Kataria & Sons.
3. Kenney, W. F. (2012). Energy conservation in the process industries. Academic Press.

Internet /Intranet
(Elective)
EG3206EEX.5

Year: III **Total: 5 hours /week**
Part: II **Lecture: 4 hours/week**
Tutorial: hour/week
Practical: 2/2 hours/week
Lab: hours/week

Course Description:
The focus of this course is on the practical application of internetworking technologies to private intranets for information management and public internets for electronic commerce students will learn theoretical details, strategies for designing sites, techniques for creating their technical infrastructures, methods for developing content, and techniques for site deployment and management. Students will develop various intranet and internet applications and setup servers as part of practical session.

Course Objectives:
On completion of this course, the students will be enabled to:
1. Familiarize with public Internets and private Intranets.
2. Explain various layers and Internet protocols.
3. Illustrate http and web servers.
4. Introduce fundamental applications of Internet and Intranet
5. Design internet server and systems

Course contents:

Theory

Unit 1. Introduction **[7 Hrs.]**
1.1. History and Development of Internets and Intranets
1.2. IANA and ISPs for internet number management
1.3. Internet Domain and Domain Name System
1.4. Internet Access Overview
1.5. Internet Backbone Networks
1.6. Optical Backbone
1.7. Marine Cables
1.8. Teleports
1.9. Satellite
1.10. Terrestrial Links

Unit 2. Internet Protocol Overview **[9 Hrs.]**
2.1. TCP/IP and the IP Layer overview
2.2. IP Address and its application
2.3. IPv4 Address Types and Formats
2.4. Subnetting concept
2.5. Implementation Perspectives of SMTP, FTP, POP, IMAP

Unit 3. HTTP and the Web Services [10 Hrs.]

3.1. Web Basics: WWW, Static and Dynamic Web Page; Web Clients; Web Servers
3.2. Client Server Architecture
  3.2.1. Single Tier, Two-Tier, Multi-Tier
  3.2.2. HTTP: HTTP Request and Response
  3.2.3. URL
  3.2.4. Client-Side Scripting
  3.2.5. Server-Side Scripting
  3.2.6. Concept of Web 1.0, Web 2.0
3.3. Basics of AJAX
  3.3.1. Introduction to XML and its Application
  3.3.2. Syntax Rules for creating XML document

Unit 4. Routing Protocols in Internet [8 Hrs.]

4.1. Introduction of routing protocol Routing
  4.1.1. Information Protocol (RIP)
  4.1.2. Open Shortest Path First (OSPF)
  4.1.3. Border Gateway Protocol (BGP)
4.2. Routing Algorithms
  4.2.1. The Link-State (LS) Routing Algorithm
  4.2.2. The Distance-Vector (DV) Routing Algorithm

Unit 5. Designing Internet Systems and Servers [7 Hrs.]

5.1. Designing of Internet System Network Architecture
5.2. Choice of platforms
5.3. Server Concepts: WEB, MAIL
5.4. Cookies
5.5. Load Balancing: Proxy Arrays
5.6. Server Setup and Configuration Guidelines
5.7. Security and System Administration Issues
5.8. Firewalls and Content Filtering

Unit 6. Internet and Intranet Systems Development [12 Hrs.]

6.1. Introductions
6.2. Benefits and drawbacks of intranets
6.3. Intranet Implementation Guidelines
6.4. Content Management System and Publishing
6.5. Intranet Design with Open-source Tools: WORD PRESS, DRUPAL, JUMLA

Unit 7. Internet and Intranet Applications [7 Hrs.]

7.1. Multimedia and Digital Video/Audio Broadcasting
  7.1.1. Video/Audio Conferencing
  7.1.2. Internet Relay Chat (IRC)

7.2. VoIP Concepts.
7.3. Datacenters
7.4. Fundamental of e-Commerce
7.5. Concept of Grid and Cloud Computing

Practical: **15 hrs**

1. Install Network Operating Systems (Windows Server).
2. Assign class of IP address to end user devices
3. Familiarization with Network Command/
4. Installation Client/Server Architecture
   4.1. Install Server
   4.2. Install Active Directory
      4.2.1. Create users
      4.2.2. Assign Rights and permission
   4.3. Configure Clients
   4.4. Perform File and Printer sharing (with Security Implementation)
   4.5. Assign the right to each resource.
   4.6. Perform Remote Access
5. Perform Routing Configuration (RIP)
6. Configure DNS
7. Configuration of Windows Firewall.
8. Web Page Development Using Open-Source Tools

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	Introduction	7	9
2	Internet Protocol Overview	9	12
3	HTTP and the Web Services	10	14
4	Routing Protocols in Internet	8	11
5	Designing Internet Systems and Servers	7	9
6	Internet and Intranet Systems Development	12	16
7	Internet and Intranet Applications	7	9
	Total	**60**	**80**

* There could be minor deviation in mark distribution.

References:

1. A.S. Tanenbaum, “Computer Networks”, 3rd Edition, Prentice Hall India, 1997.
2. D. Minoli, “Internet and Intranet Engineering”, MCGraw-Hill,1997
3. D.E. Comer, “Internetworking with TCP/IP”. Prentice Hall

Satellite Communication
(Elective)
EG3206EEX.6

Year: III **Total: 5 hours /week**
Part: II **Lecture: 4 hours/week**
Tutorial: hour/week
Practical: 2/2 hours/week
Lab: hours/week

Course Description:
This course deals with satellite communication, orbital mechanics and VSAT technology.

Course Objectives:
1. Familiarize with satellites and satellite services
2. Relate satellite systems to other terrestrial systems
3. Define the terms: satellite orbits, launching, link design, multiple access techniques, propagation effects and their impact on satellite-earth links
4. Explain VSAT systems, Satellite TV, radio and GPS

Course contents:

Theory

Unit 1. Overview of Satellite Communication [4 Hrs.]
1.1. Communication Satellite System
1.2. History of Satellite Communication
1.3. Frequency Allocations for Satellite Services
1.4. Merits and Demerits of Satellite Communication
1.5. Active and Passive Satellites
1.6. Applications of Satellites

Unit 2. Orbital Mechanics [12 Hrs.]
2.1. Newton's law
2.2. Kepler's laws
2.3. Orbital parameters
2.4. Orbital Mechanics
2.5. Look Angle Determination
2.6. Orbital perturbations
2.7. Orbit Control system
2.8. Geo stationary orbit
2.9. Telemetry, tracking and Command
2.10. Satellite Power systems
2.11. Transponders
2.12. Satellite Antennas

Unit 3. Satellite Link Design [13 Hrs.]
3.1. Basic transmission Theory, System noise temperature and G/T ratio,
3.2. Design of Uplinks and downlinks,
3.3. EIRP, PFD, Path Loss
3.4. Receiving Signal Intensity

3.5. Link Budget Calculations

Unit 4. Multiple Access Techniques for Satellite Links [6 Hrs.]

4.1. Multiple access
4.2. Frequency Division Multiple Access
4.3. Time Division Multiple Access
4.4. Demand access Multiple Access
4.5. Code division Multiple Access
4.6. On board processing

Unit 5. Propagation Effects on Satellite-Earth Links [6 Hrs.]

5.1. Signal Attenuations
5.2. Propagation Effects in the Atmospheric Layers
5.3. Tropospheric and Ionospheric Effects
5.4. Rain Attenuation
5.5. Polarization in Ionosphere
5.6. Ionospheric Scintillation

Unit 6. VSAT Systems [6 Hrs.]

6.1. Network architectures
6.2. Access control protocol
6.3. Basic techniques
6.4. Satellite Earth station engineering
6.5. System design procedures

Unit 7. Satellite Applications [13 Hrs.]

7.1. Non-geostationary Satellite Systems
7.2. Broadcasting Satellites
7.3. Home Satellite TV
7.4. Satellite Radio
7.5. Meteorological Satellites
7.6. Remote Sensing Satellites
7.7. Global Positioning System
7.8. Military Satellites
7.9. Spy, Search and Rescue Satellites

Practical: [15 Hrs.]

1. Conduct a field visit to Satellite Stations, such as Sagarmatha Earth Stations, DishHome, IPTV Providers etc.
   1.1. Observe systems and Note Points
   1.2. Prepare a report and present in the class.

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	Overview of Satellite Communication	4	6

2	Orbital Mechanics	12	16
3	Satellite Link Design	13	17
4	Multiple Access Techniques for Satellite Links	6	8
5	Propagation Effects on Satellite-Earth Links	6	8
6	VSAT Systems	6	8
7	Satellite Applications	13	17
	Total	**60**	**80**

* There could be minor deviation in mark distribution.

References:

1. Timothy Pratt, Charles Bostian and Jeremy Allnutt, "Satellite Communications", John Willy & Sons (Asia) Pvt. Ltd.
2. Dennis Roddy, "Satellite Communications", McGraw-Hill Publication.
3. James Martyn, "Communication Satellite systems", Prentice Hall.
4. Wilbur L. Pritchard, Hendri G. Suyderhoud and Robert A. Nelson, "Satellite Communication Systems Engineering", Prentice Hall/Pearson.
5. M.Richharia, "Satellite Communication Systems-Design Principles", Macmillan.
6. Emanuel Fthenakis, "Manual of Satellite Communications", McGraw Hill Book Co.

Experts involved in Curriculum Revision, 2022

1. Ram krishna Maharjan Institute of Engineering, Pulchok Kathmandu.
2. Sanjivan Satyal Institute of Engineering, Pulchok Kathmandu.
3. Shanta Maharjan, Institute of Engineering, Thapathali, Kathmandu.
4. Reeta Shilpakar, Nepal Banepa Polytecnic Institute Kavre.
5. Pradip Neupane Balaju School of Engineering and Technology Balaju Kathmandu.
6. Rajendra Prasad Bhatta Balaju School of Engineering and Technology Balaju Kathmandu.
7. Sushil Kumar Chandrabansi Balaju School of Engineering and Technology Balaju Kathmandu.
8. Subash Adhikari Kathmandu Institute of Technology, Kathmandu.
9. Manish Bhagat, Nepal Banepa Polytecnic Institute Kavre.
10. Anup Tiwari Kathmandu Institute of Technology, Kathmandu.
11. Bikash Kumar Singh, Nepal Banepa Polytecnic Institute Kavre.
12. Rajesh P Chataut Balaju School of Engineering and Technology Balaju Kathmandu.
13. Suroj Burlakoti, National College of Engineering, Lalitpur.