CURRICULUM

DIPLOMA

Electrical Engineering

(Three-year program-semester system)

Council for Technical Education and Vocational Training

Curriculum Development and Equivalence Division

Sanothimi, Bhaktapur

2008

First Revision 2014

Second Revision 2022

Contents

Introduction

Electrical 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 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 engineering.

Rationale of Revision

Engineering is a progressive and 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 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:

- It crossed the 5 years maturity period of its implementation after its first revision in 2014 and similarly 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 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 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 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 hours will not be less than 15 weeks in each semester.

Medium of Instruction

The medium of instruction is in English and/or 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/ 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 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

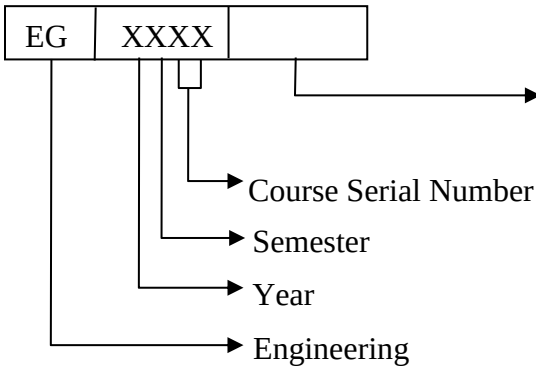
A student should demonstrate following general attitudes for effective and active learning.
Acceptance, Affectionate, Ambitious, Aspiring, Candid, Caring, Change, Cheerful, Considerate, Cooperative, Courageous, Decisive, Determined, Devoted, Embraces, Endurance, Enthusiastic, Expansive, Faith, Flexible, 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 engineering discipline such as Micro Hydro, Instrumentation System and Renewable Energy Technology, are offered here with the provision of the 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 Engineering

Year: I **Part: I**

S.N.	Code No.	Subject	Teaching Scheme						Examination Scheme DISTRIBUTION OF MARKS						Total Marks	Remarks
			Mode				Weekly Hours	Credit Hours	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 DISTRIBUTION OF MARKS						Total Marks	Remarks
			Mode				Weekly Hours	Credit Hours	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**	

Year: II **Part: I**

S.N.	Code No.	Subject	Teaching Scheme						Examination Scheme DISTRIBUTION OF MARKS						Total Marks	Remarks
			Mode				Weekly Hours	Credit Hours	Theory			Practical				
			L	T	P	Lab			*Assmt. Marks	Final		*Assmt. Marks	Final			
										Marks	Time (Hrs.)		Marks	Time (Hrs.)		
1	EG2101EE	Fundamental of Electrical Engineering	3	1		2	6	4	20	80	3	30	20	3	150	*Continuous assessment
2	EG2102EE	Computer Programming	2			2	4	3	10	40	1.5	30	20	3	100	
3	EG2103EE	Basic Electronics and Logic circuits	4	1		3	8	5	20	80	3	30	20	3	150	
4	EG2104EE	Civil Construction and Survey	3	1	2		6	4	20	80	3	30	20	3	150	
5	EG2105EE	Electrical Engineering Material	4				4	4	20	80	3				100	
6	EG2106EE	Principles of Management and Costing	4				4	4	20	80	3				100	
7	EG2107EE	Electrical Installation I	1		4		5	2				60	40	4	100	
8	EG2108EE	Electrical Engineering Drawing I			3		3	2				30	20	3	50	
		Total	**21**	**3**	**9**	**7**	**40**	**28**							**900**	

Year: II **Part: II**

S.N.	Code No.	Subject	Teaching Scheme						Examination Scheme DISTRIBUTION OF MARKS						Total Marks	Remarks
			Mode				Weekly Hours	Credit Hours	Theory			Practical				
			L	T	P	Lab			*Assmt. Marks	Final		*Assmt. Marks	Final			
										Marks	Time (Hrs.)		Marks	Time (Hrs.)		
1	EG2201EE	Microprocessor	3	1		2	6	4	20	80	3	30	20	3	150	*Continuous assessment
2	EG2202EE	Computer Aided Design	2		3		5	3	10	40	1.5	30	20	3	100	
3	EG2203EE	Electric Circuit Analysis	3	1		2	6	4	20	80	3	30	20	3	150	
4	EG2204EE	Electrical Installation II			4		4	2				60	40	4	100	
5	EG2205EE	Electrical Engineering Drawing II			3		3	2				30	20	3	50	
6	EG2206EE	Electrical Machines I	3	1		2	6	4	20	80	3	30	20	3	150	
7	EG2207EE	Electrical Instruments and Measurement	3	1		2	6	4	20	80	3	30	20	3	150	
8	EG2208EE	Power Stations	4				4	4	20	80	3				100	
		Total	**18**	**4**	**10**	**8**	**40**	**27**							**950**	

Year: III **Part: I**

S.N.	Code No.	Subject	Teaching Scheme						Examination Scheme DISTRIBUTION OF MARKS						Total Marks	Remarks
			Mode				Weekly Hours	Credit Hours	Theory			Practical				
			L	T	P	Lab			*Assmt. Marks	Final Marks	Final Time (Hrs.)	*Assmt. Marks	Final Marks	Final Time (Hrs.)		
1	EG3101EE	Switchgear and Protection	4		2		6	5	20	80	3	30	20	3	150	*Continuous assessment
2	EG3102EE	Power Electronics	3			2	5	3	20	80	3	30	20	3	150	
3	EG3103EE	Electrical Machines II	3	1		3	7	5	20	80	3	30	20	3	150	
4	EG3104EE	Electrical Design and Estimation	3		2		5	4	20	80	3	30	20	3	100	
	EG3105EE	Utilization of Electrical Energy	4				4	4	20	80	3				100	
5	EG3106EE	Fundamentals of Control System	3			2	5	4	20	60	3	30	20	3	150	
6	EG3107EE	Electrical Repair and Maintenance I	1		3		4	3				30	20	4	100	
7	EG3108EE	Project I			4		4	2				60	40	4	100	
		Total	**21**	**1**	**11**	**7**	**40**	**30**							**1000**	

Year: III **Part: II**

S.N.	Code No.	Subject	Teaching Scheme						Examination Scheme DISTRIBUTION OF MARKS						Total Marks	Remarks
			Mode				Weekly Hours	Credit Hours	Theory			Practical				
			L	T	P	Lab			*Assmt. Marks	Final Marks	Final Time (Hrs.)	*Assmt. Marks	Final Marks	Final Time (Hrs.)		
1	EG3201EE	Electrical Energy Audit	3		2/2		4	4	20	80	3	25		3	125	*Continuous assessment
2	EG3202EE	Project II			6		6	3				90	60	6	150	
3	EG3203EE	Power System Operation and Maintenance	3			3	6	5	20	80	3	30	20	3	150	
4	EG3204EE	Electrical Repair and Maintenance II	1		3		4	3				30	20	3	50	
5	EG3205EE	Industrial Attachment			6		6	3				60	40	4	100	
6	EG3201MG	Entrepreneurship Development	3		2		5	4	20	60	3	30	20	3	100	
7	EG3206EE	Transmission and Distribution of Electrical Power	3	1			4	3	20	80	3				100	
8		Elective	3		2		5	4	20	80	3	30	20	3	150	
	EG3207EE.1	a) Micro Hydro Power														
	EG3207EE.2	b) Instrumentation System														
	EG3207EE.3	d) Renewable Energy Technology														
		Total	**16**	**1**	**20**	**3**	**40**	**29**							**925**	

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	Fundamental of Electrical Engineering
2	EG2102EE	Computer Programming
3	EG2103EE	Basic Electronics and Logic circuits
4	EG2104EE	Civil Construction and Survey
5	EG2105EE	Electrical Engineering Material
6	EG2106EE	Principles of Management and Costing
7	EG2107EE	Electrical Installation I
8	EG2108EE	Electrical Engineering Drawing I

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: hour/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**	**Hours**	**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:

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

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

Basic Electronics and Logic Circuit

EG2103EE

Year: II **Total: 8 hours /week**

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

Tutorial: 1 hour/week

Practical: hours/week

Lab: 3 hours/week

Course Description:

The use of electronics, specifically the semiconductors in electrical controls has expanded in recent years has made a strong need of knowledge in electronics for technician. Keeping in view with this need, the electronics course has designed to provide practical and essential theory about modern components in particular on linear circuits.

Course Objectives:

On completion of this course the students will be able to

1. Provide practical and essential theory on modern electronic linear components
2. Provide technical and analytical skills to use of electronics in electrical controls

Course Contents:

Theory

Unit 1. Introduction of Electronics [1 Hrs.]

1.1. Importance of electronics in modern society.

1.2. Use of electronics in electro mechanical control system and automation

Unit 2. Introduction to electronic passive components [4 Hrs.]

2.1. Resistors and potentiometers

2.1.1. Introduction, Classification and Demonstration of various types of Fixed Resistors and Variable

2.1.2. Resistors, Resistor Color Codes.

2.1.3. Characteristics, Application and Demonstration of Thermistors, LDR.

2.2. Inductive components

2.2.1. Introduction, Classification and Demonstration of various type of to Inductive Components and basic

2.3. Construction.

2.3.1. Types of Inductors used in electric & electronic circuit.

2.3.2. Capacitors

2.3.3. Introduction, Classification and Demonstration of Capacitance and Capacitor and basic construction and units.

2.3.4. Types of Capacitors and their application in Electrical & Electronic circuit

Unit 3. Semiconductor diode [4 Hrs.]

3.1. PN junction diode

3.1.1. Introduction to PN Junction Diode, basic construction, forward and reverse characteristics

3.1.2. Types of Diode and their application in Electric and Electronic Circuit

3.1.3. Checking of Diode using Ohm Meter

3.2. Zener diode
- 3.2.1. Basic construction and operation of a Zener diode
- 3.2.2. Forward and reverse bias Characteristics of a Zener diode
- 3.2.3. Application of Zener Diode as a Voltage Regulator

Unit 4. Introduction to bi-polar junction transistor (BJT) [4 Hrs.]

4.1. Basic structure of BJT, PNP and NPN type

4.2. Biasing of PNP and NPN Transistor principles of operation

4.3. Voltage and Current Characteristics. Input and Output Characteristics, Collector current as a function of base current (Family of Collector characteristics curve), Cutoff, Saturation and DC Load line

4.4. Demonstration various types of Transistors, Transistor Rating and interpretation of Transistor Data sheet

4.5. Testing of Transistor by using Ohm meter

Unit 5. Transistor amplifiers circuits [9 Hrs.]

5.1. Introduction, Principles of operation and characteristics to Common Emitter (CE) Amplifier, Common Collector (CC) Amplifier and Common Base (CB) Amplifier circuit

5.2. Transistor Leakage current (I_{CBO}, I_{CES}, &I_{CEO}) & Temperature stability Transistor circuit, use of Heat sink to prevent the Transistor from overheating

Unit 6. Special semiconductor devices [4 Hrs.]

6.1. Basic construction, Voltage - Current characteristics and application of SCR, UJT, JFET, MOSFET, Photo Diode, Opto Coupler and Varactor Diode

Unit 7. Introduction to digital electronics and number system [10]

7.1. Introduction to Analogue and Digital Signal

7.2. Two state operation and its advantages

7.3. Decimal Number System

7.4. Binary Number System

7.5. Octal Number System

7.6. Hexa -Decimal Number System

7.7. Conversion of Number system

7.8. Addition, Subtraction, Multiplication, Division

7.9. Signed and Unsigned Binary Numbers

7.10. Binary Coded Decimal Numbers and ASCII Codes

Unit 8. Fundamentals of digital electronics [10 Hrs.]

8.1. Introduction to Logic Gates (NOT, AND, OR, NAND, NOR XOR)
- 8.1.1. Symbols, Truth Tables, Boolean algebra and Associate Rules
- 8.1.2. Boolean algebra and Associate Rules
- 8.1.3. De-Morgan's Theorem
- 8.1.4. Universal Gate conversion
- 8.1.5. Minimization of Logical Expressions using Boolean algebra

8.1.6. Application of Karnaugh Map (K-Map) for minimization of Logical expressions

Unit 9. Introduction to combinational logic devices [6 Hrs.]

9.1. Encoder / Decoder-Decimal to Binary, Binary to Gray Code, Priority Encoder
9.2. Seven Segment Display Decoder
9.3. Multiplexer and De-Multiplexer
9.4. Parity Generator and Checker
9.5. Half Adder, Full Adder and Subtractor
9.6. Nibble and Bite Adder and Subtractor

Unit 10. Introduction to analog and digital conversion [4 Hrs.]

10.1. Analogue to Digital (A/D) Conversion
10.2. Digital to Analogue (D/A) Conversion

Unit 11. Introduction to sequential logic devices [4 Hrs.]

11.1. Mono-stable, Bi-stable and A stable Devices
11.2. Latches and Flip-flop
11.3. Triggering of Flip-flop
11.4. SR and D Flip-flop
11.5. Clocked Flip-flop
11.6. JK, T Flip-flop

Practical: [45 Hrs.]

1. Introduce Laboratory Equipment.
2. Verify the PN Junction Diode and Zener Diode Characteristics.
3. Construct and check Diode Rectifier and Filter Circuits.
4. Perform the Function and Operation of Logic Gates and Verification of Truth Table. Of NOT, AND, OR, NAND, NOR, XOR.
5. Verify De-Morgan's Theorem
6. Construct and verify Encoder and Decoder.
7. Convert Analogue to Digital (A/D) using R- 2R Ladder Circuit.
8. Test JFET Transistor Characteristics.

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	Introduction of Electronics:	1	2
2	Introduction to electronic passive components	4	4
3	Semiconductor diode	4	6
4	Introduction to bi-polar junction transistor (bjt).	4	6
5	Transistor amplifiers circuits	9	10
6	Special semiconductor devices	4	6
7	Introduction to digital electronics and number system	10	12

8	Fundamentals of digital electronics	10	14
9	Introduction to combinational logic devices	6	8
10	Introduction to analog and digital conversion	4	6
11	Introduction to sequential logic devices	4	6
	Total	**60**	**80**

* There may be minor deviation in marks distribution.

References

1. Grob Bernard,"Basic Electronics",McGraw-Hil,2002
2. Malvino Albert,"Electronics Principles", McGraw-Hill,2007
3. Thomas L.Floyd ,"Electronic Devices",Prentice Hall,2012
4. Gupta J.B.,"Electronic Devices and Circuits",S.K. Kataria & Sons,2013
5. Malvino Albert,"Digital Computer Electronics", McGraw-Hill,2019

Civil Construction and Survey

EG2104EE

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

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

Tutorial: 1 hour/week

Practical: 2 hours/week

Lab: hours/week

Course Description:

This course deals with the fundamental concept of surveying & basic civil construction works related to electrical Engineering.

Course Objectives:

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

1. Familiarize building materials, walls, roofs, floor, foundation, cable trench, select and use correct building materials
2. Associate/differentiate concrete and mortar mixes
3. Identify and use surveying instruments to measure length, angles, and heights.
4. Level survey and peg for overhead power lines.

Course Contents:

Theory

Section A: Civil Construction

Unit 1. Introduction to Civil Construction [8 Hrs.]

1.1. Construction materials, types of materials, availability (sand, lime, cement, aggregates, brick, block, wood, steel etc.), their main specifications, supply sources and prices.

1.2. Walls – load bearing and partition, their features, material used and construction.

1.3. Types of roofs – pitched and flat, their features

1.4. Floors – solid and suspended floors, their features

1.5. Cable trench through floor, its construction detail

Unit 2. Foundations [10 Hrs.]

2.1. Introduction

2.2. Basic soil mechanics, basic requirements for load bearing structures, drainage, bearing capacity

2.3. Functions of foundation

2.4. Types of foundations (shallow: individual, combined, mat; deep: pile) commonly used with special emphasis on electrical machines, poles and towers, requirements and design criteria

2.5. Foundation plans and sections – interpretation and use

2.6. Concrete mixes and mortar preparations, use and applications

Unit 3. Walls and Supports [6 Hrs.]

3.1. Introduction

3.2. Load bearing walls/support – brick, concrete block, stone masonry (rubble, ashlar), method of construction and tools used

3.3. Openings in walls – for doors, window etc. Use of lintel/ beam, sills and jambs. UPVC, timber and steel for construction of window and door, methods of construction

Unit 4. Drainage [6 Hrs.]

4.1. Introduction
4.2. Need for adequate drainage in and around the building
4.3. Simple surface water drainage system, water flow principle
4.4. Combined surface water and sewage drains, connection and fittings

Practical: [15 Hrs.]

1. Organize a tour/study visit around the campus and nearby building, observe and note down the following constructional features:
   1.1. Safety in building sites – use of scaffolding, ladder, hoist and lifting equipment. Damper from falling objects, safe handling, stacking of materials.
   1.2. Drainage, trench system around the campus area and plumbing system
2. Read and interpret civil/building drawings in detail.

Section B: Surveying

Unit 1. Introduction to Surveying [3 Hrs.]

1.1. Need for surveying and leveling in overhead line, switch yard, transmission tower, construction
1.2. Principles used in surveying and levelling
1.3. Types of surveying equipment: Tapes, Chains, Levels, Theodolite, total station, clinometer

Unit 2. Distance Measurement [3 Hrs.]

2.1. The chain and tape – their construction, use and care
2.2. Use of tape – errors and accuracy in taping
2.3. Use of chain – accuracy in chain measurements
2.4. Use of theodolite for distance measurement

Unit 3. Angle Measurement [3 Hrs.]

3.1. Measurements of horizontal angles by using compass, level, and theodolite/total station.
3.2. Measurement of vertical angles using theodolite/total station/ clinometer
3.3. Methods of measuring vertical height and horizontal distance

Unit 4. Leveling for Building Sites [3 Hrs.]

4.1. The Principles of leveling choice of datums, use of staff and level

Unit 5. Survey and Leveling of Power Lines [3 Hrs.]

5.1. The principal factors in routing overhead power lines, levelling, surveying and pegging of route
5.2. Traversing (close and open)

Practical: [30 Hrs.]

1. Identify and list out instrument and equipment commonly used in surveying
2. Measure with tape and chain over different ground conditions and record distance measurement
3. Perform distance measurement across an obstacle.
4. Measure horizontal and vertical angles using theodolite/total station/clinometer
5. Measure horizontal distance and vertical height (overhead line poles, towers)
6. Draw cross-section of a site to show variations in level and Longitudinal Profile for Transmission Tower or overhead line.
7. Prepare a topographical map from traversing.

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
Section A	**Civil Construction**		
1	Introduction to Civil Construction	8	15
2	Foundations	10	18
3	Walls and Supports	6	11
4	Drainage	6	11
Section B	**Surveying**		
1	Introduction to Surveying	3	5
2	Distance Measurement	3	5
3	Angle Measurement	3	5
4	Leveling for Building Sites	3	5
5	Survey and Leveling of Power Lines	3	5
	Total	**45**	**80**

* There may be minor deviation in marks distribution.

References:

1. *Reinforced Concrete Foundation* by Fergusen
2. *A text book of Surveying* by C. L. Kochher
3. *Standard Handbook of Civil Engineers* by F.S. Neritt
4. *Building Drawings* by Shaha

Electrical Engineering Material

EG2105EE

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.

Principles of Management and Costing

EG2106EE

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 is designed to develop understanding about principles and functions of management.
It also deals with basic concepts of accounting, benefit and cost analysis and project risk.

Course Objectives:

After completing this course, the students will be able to

1. Familiarize with organization and management.
2. Explain human resource management, motivation and leadership.
3. Apply skills for cash flow transaction, depreciation, interest rate calculation, financial analysis.

Course Contents:

Theory

First Part: Management

Unit 1. Organization and Management [8 Hrs.]

1.1. Definition of Organization and Management
1.2. Need of Organization and Management
1.3. Principles of Management (Henri Foyal)
1.4. Functions of Management (Planning, Organizing, Controlling, Supervision, Directing, Leading, Motivation etc.)
1.5. Types of Traditional Organizations (Simple Functional and Divisional)
1.6. Types of Modern Organizations (Matrix, Team and Network)
1.7. Ownership of Organization

Unit 2. Human Resource Management [6 Hrs.]

2.1. Introduction
2.2. Job Analysis
2.3. Human Resource Selection Process
2.4. Socializing the New Employees
2.5. Labor Welfare Schemes
2.6. Accidents and Safety measures

Unit 3. Motivation and Leadership [8 Hrs.]

3.1. Definition
3.2. Functions of a Leader
3.3. Motivation Theory: Maslow's Need theory, Herzberg's two factor theory and MC Gregor theory x and theory Y
3.4. Strategies for Motivating Employees
3.5. Managing Conflicts in the Organization

Unit 4. Strategy and Environmental Scanning [6 Hrs.]

4.1. Strategic Planning
4.2. Environmental Scanning/ SWOT analysis (External and Internal Analysis)
4.3. Project analysis and project appraisal
4.4. Environmental and Technology (Today Perspective, with case study)
4.5. Technology and Society

Unit 5. Marketing [8 Hrs.]

5.1. Definition of Market and Marketing
5.2. Marketing Mix
5.3. Concept of channel of distribution (For heavy equipment, one-time purchase items)
5.4. Sales Promotion
5.5. Role of Technical Human Resources in marketing process.

Second Part: Costing

Unit 6. Basic Accounting [12 Hrs.]

6.1. Introduction
6.2. Role of Engineering /Technical Human Resources in an Organization
6.3. 6.2 Types of Engineering Economics Decision
6.4. Finance and Capital Management
  6.4.1. Sources of finance for investment
  6.4.2. Concept of assets and liabilities
  6.4.3. Accounting - Basic Concept (definition, objectives and importance of accounting, concept of debit and credit, profit and loss account, balance sheet)
  6.4.4. Simple and compound interest rates, effective interest and continuous compound interest
  6.4.5. Deprecation, its types and factors that affect it
  6.4.6. Depreciation methods: straight line, declining balance method
  6.4.7. Cash flow
  6.4.8. Related numerical problems on interest and depreciation

Unit 7. Financial Analysis [6 Hrs.]

7.1. Introduction
7.2. Calculation of benefits and costs
7.3. Definition on Benefits/Cost (B/C) Ratio, Net Present Value (NPV), Payback Period
7.4. Numerical problems on 7.1 and 7.2

Unit 8. Project Risk [6 Hrs.]

8.1. Definition
8.2. Types of Project Risks during Construction and Operation of the Project
8.3. Managing Probable Risks in the Project
8.4. Sensitivity Analysis
8.5. Breakeven Analysis
8.6. Related numerical problems on 8.4 and 8.5

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
First Part	**Management**		
1	Organization and Management	8	11
2	Human Resource Management	6	8
3	Motivation and Leadership	8	11
4	Strategy and Environmental Scanning	6	8
5	Marketing	8	11
Second Part	**Costing**		
6	Basic Accounting	12	15
7	Financial Analysis	6	8
8	Project Risk	6	8
	Total	**60**	**80**

* There may be minor deviation in marks distribution.

References:

1. Principles of Management, Philip Kotler, TEE Publication
2. Industrial Engineering and Management, TR Banga
3. Industrial Management, VK Sharma, OP Harkut
4. Agrawal, G.R (2003) Principles of Management in Nepal. M.K. Publishers and distributors, Kathmandu, Nepal
5. Mahajan, M. (2002), Industrial Engineering and production management (2nd ed.), DhanpatRai and Co. (P) Ltd., Delhi
6. Chan S. Park, 2002,Comtemporary Engineering Economics, Third Edition, Prentice-Hall IndiaPvt. Ltd., New Delhi, India, ISBN-81-203-2143-X.
7. R Panneerselvam, 2001, "Engineering Economics", First Edition, Prentice-Hall of India Pvt. Ltd., New Delhi, ISBN-81-203-1743-2
8. Decenzo, David A. and Robbins, Stephen P. (1997). Personal/ Human Resource Management (3rd ed.), Prentice Hall of India, New Delhi.
9. Dessler, Gary (2002). A Framework of Human Resource Management (2nd ed.) Pearson Education Asia, India.

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 Engineering Drawing I

EG2108EE

Year: II **Total: 3 hours /week**

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

Tutorial: hour/week

Practical: 3 hours/week

Lab: hours/week

Course Description:

This course deals with lighting, D.C. motor, D.C. generator, and motor winding diagrams distribution diagrams

Course Objectives:

On completion of this course the students will able to:

1. Use electrical symbol.
2. Interpret wiring diagrams.
3. Prepare the layout and wiring diagrams for buildings and equipment.
4. Prepare schematic diagrams from wiring diagrams.
5. Draw free hand sketches of components, equipment and electrical circuits.

Course Contents:

Practical:

Sheet 1. **[3 Hours]**

1.1. Identify subject, size of drawing sheet, type of diagrams, drawing symbols.

1.2. Draw bell, indicator, fire, and burglar alarm circuits, explain working principle and lay out diagram.

Sheet 2. Draw simple, two way and intermediate switches connection for building lighting and impulse relay and timer for street lighting. **[3 Hours]**

Sheet 3. Draw connection diagram for ammeter and voltmeter: **[3 Hours]**

3.1. Direct on line

3.2. Using shunt and multiplier

3.3. Using current transformer and Potential transformer

Sheet 4. Perform the following: **[3 Hours]**

4.1. Draw layout diagram for single-phase consumer "intake" including 8-way distribution board, eight numbers of 15-amp power socket, twenty-two no. of light point and one single phase pump motor on an architect's floor plan of a simple residential building with four rooms.

4.2. Make a bill of quantities of all the items required for the conceal installation.

Sheet 5. Draw connection diagram of DC generator and its control circuit. **[3 hours]**

5.1. Separately excited

5.2. Series

5.3. Shunt

5.4. Compound wound

Sheet 6. Draw connection diagram of armature winding and its control circuit. **[3 hours]**

6.1. Series

6.2. Shunt

6.3. Compound wound

Sheet 7. Draw connection diagram of 220V/ 6V.AC to DC conversion adopter with half Wave and full wave rectification providing necessary filter **[3 Hours]**

Sheet 8. Draw wiring and connection diagram for a refrigerator compressor motor circuit using single phase capacitor motor, starting relay, thermostat and series over load relay. **[3 Hours]**

Sheet 9. Draw connection and diagram of capacitor start, capacitor run and capacitor start and Run motor. **[3 Hours]**

Sheet 10. Draw the wiring circuit of a change over switch to control stand by and main supply. Then list out the main parts of stand by supply system: **[3 hours**]

10.1. Change over switch.
10.2. Generator.
10.3. Photovoltaic system.
10.4. NEA supply (Main supply).

Sheet 11. Draw Armature winding diagram of four poles, simplex, retrogressive wave winding with commutator pitch of 1 and 12. **[3 Hours]**

Sheet 12. Draw detail installation diagrams of plate electrode/ Pipe electrode earthing system with watering provision and make a bill of quantity. **[3 Hours]**

Sheet 13. Draw detail layout and installation diagram of 3 phase 4 wire distribution line along street with provision for street light, pole, brackets, stay-pole protection-shackle insulator, stay insulator set. **[3 hours]**

Sheet 14. Draw detail panel board fabrication diagram of 250 Amp incoming MCCB: **[3 Hours]**

14.1. 3×100 Amp outgoing MCCB
14.2. 2×60 Amp outgoing MCCB
14.3. 2×40 Amp outgoing MCCB
14.4. 2×20 Amp outgoing MCCB
14.5. 1×20 Amp Black space
14.6. 300 Amp TPN Busbar, earth busbar, Voltmeter, Ammeter CTS – selector switches, indicator all complete.

Sheet 15. Draw layout diagram of typical indoor/ outdoor substation –11KV/ 33KV/66KV system. **[3 Hours]**

References:

1. Gupta, J.B. (2020). A course in Electrical Installation, Estimation & Costing. S.K. Katariya & Sons, India.
2. Lister, Eugen C. (1993). Electrical Circuit and machines. McGraw-Hill.
3. Roe, L.B. (1972). Practices and Procedure of Industrial Electrical Design. McGraw-Hill.
4. Rosenberg, Robert, August Hand (1946). Electric motor Repair (3rd ed.) murray Hill books, New York.
5. Singh, Surjit (2020). Electrical Engineering Drawing. S.K. Katariya & Sons, India.
6. Say, M.G. (1962). Electrical Design manual. Chapman & Hall.

Second Year/Second Part

S.N.	Course Code	Subject
1	EG2201EE	Microprocessor
2	EG2202EE	Computer Aided Design
3	EG2203EE	Electric Circuit Analysis
4	EG2204EE	Electrical Installation II
5	EG2205EE	Electrical Engineering Drawing II
6	EG2206EE	Electrical Machines I
7	EG2207EE	Electrical Instruments and Measurement
8	EG2208EE	Power Stations

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

Computer Aided Design

EG2202EE

Year: II **Total: 5 hours /week**
Part: II **Lecture: 2 hours/week**
Tutorial: hour/week
Practical: 3 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 [4 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 [8 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 **[5 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 Drawing **[3 Hrs.]**

7.1. Use of AutoCAD Design center
7.2. Layout drawing using standard symbols
7.3. Layout management

Unit 8. Plotting drawings **[3 Hrs.]**

8.1. Using Layout to set up a print
8.2. Device information, pen parameters, paper size and orientation
8.3. Scale, rotation and origin
8.4. Printing a drawing

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) 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. Draw electrical symbols in AutoCAD
Lab 5. Use/Insert command in AutoCAD
5.1. ERASE, OFFSET, COPY, MOVE, CHPROP, ROTATE, MIRROR, ARRAY, FILLET, TRIM, LTTYPE, LTSCALE, DIVIDE.
Lab 6. Apply Auto CAD
6.1. Draw simple electrification of a single floor with single line diagram,
6.2. Draw industrial wiring system coordinating with control panel with respective power and control diagram.
Lab 7. Layout Drawing.
Lab 8. Plot and print drawing.

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	AutoCAD	4	5
2	Basic Commands and Drawing Aids	8	10
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	5	7
7	Layout Drawing	3	4
8	Plotting drawings	3	4
	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.

Electric Circuit Analysis

EG2203EE

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

Electrical Installation II

EG2204EE

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

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

Tutorial: hour/week

Practical: 4 hours/week

Lab: hours/week

Course Description:

This course deals with industrial motor control system, distribution of overhead lines and installation and connection of stand by generator.

Course Objectives:

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

1. Interpret power and control diagrams of single phase and three phase motors.
2. Connect and control single phase and three phase motors with various control arrangements.
3. Connect and start three phase motor by single phase supply.
4. Install overhead line: pole erection, stringing conductors, cable termination, lightning arrestor, DO-fuse, LT panel.

Course Contents:

Practical: **[60 Hrs.]**

1. Install and connect power and control circuits to start and run three phase squirrel cage induction motor by momentary push buttons with an air brake contactor, overload relay, indicating lamps etc. as per given layout diagram. **[4 Hrs.]**
2. Install and connect power and control circuits to run and stop a three-phase squirrel case induction motor from two or more stations by push buttons using air brake contactor, overload relay, indicating lamps etc. as per given layout diagram **[4 Hrs.]**
3. Install and connect power and control circuits to start and stop three phase induction motor in clock wise and counter clock wise direction by start and stop push buttons with air brake contactors, overload relay, clock wise, anti-clock wise and overload indicating lamps etc. as per given layout diagram. **[4 Hrs.]**
4. Install and connect power and control circuits to start a three-phase induction motor in star mode and run-in delta mode by manually operating push buttons with air brake contactors, overload relay, star/delta/overload indicating lamps etc. as per given layout diagram. **[4 Hrs.]**
5. Install and connect power and control circuits to start a three-phase induction motor in star mode manually and run-in delta mode automatically by push button and timer with air brake contactors, overload relay, indicating lamps etc. as per given layout diagram. **[4 Hrs.]**
6. Install and connect circuits to start and run a three-phase slip-ring induction motor by rotor resistance starter including TPMCB, OLR, three phase KWh meter, indicating lamps etc. as per given layout diagram. **[4 Hrs.]**

7. Install and connect power and control circuits to run a three phase, two speed motor by push buttons including air brake contactors, overload relay, indicating lamps etc. as per given layout diagram. **[4 Hrs.]**
8. Install and connect power and control circuits for step by step (sequence) control of three, three phase motors manually by push buttons including air brake contactors, overload relay, indicating lamps etc. as per given layout diagram. **[4 Hrs.]**
9. Install and connect power and control circuit for step by step start of three motors start first motor manually and second and third automatically by push button and timers with air brake contactors, overload relay and indicating lamps as per given layout diagram. **[4 Hrs.]**
10. Install and connect circuits to start and connect the generator backup system automatically when cutoff the power of connected supply system with necessary arrangements as per given layout diagram. **[4 Hrs.]**
11. Install and connect power and control circuits for a single-phase pump motor with water level control float switches in overhead and underground tank, air break contactor, overload relay, start and stop master push buttons, indicating lamps etc. as per given layout diagram. **[4 Hrs.]**
12. Perform/conduct/accomplish Overhead line works **[16 Hrs.]**
    (i) Erection of poles.
    (ii) Installing pole-staying set.
    (iii) Stringing conductors.
    (iv) Installing transformer, DO-fuse, lightning arrestor, LT panel, etc.
    (v) Cable/wire terminations.
    (vi) Dismantling.

References:

1. Basic principle of electrical craftsman, H.K Martin
2. The Art and Science of protective relaying, G. Mason
3. Experiments with Industrial Electrical System, D. Patric
4. Manufacturer’s catalogue of contactors, protective relays, etc.

Electrical Engineering Drawing II

EG2205EE

Year: II **Total: 3 hours /week**

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

Tutorial: hour/week

Practical: hours/week

Lab: 3 hours/week

Course Description

This course deals with control layout connection and schematic diagram of motor, generators, OCBS and Winding diagram in Computer Aided software.

Course Objectives:

On completion of this computer-based drawing course the student will be able to:

1. Draw and explain connection and control diagrams for three phase induction motors with various control arrangements.
2. Draw and explain circuit diagrams of three phase transformer showing winding connections and tapping.
3. Draw and explain wiring and connection diagram for three phase generator with Protection and OCB.
4. Draw and explain schematic diagram and tripping circuits with indications from Contactor's wiring diagrams.
5. Draw and explain winding diagrams.

Course Contents:

Practical:

Sheet 1. Draw connection diagram for 3-phase, 3hp380v star connection squirrel cage Induction motor controlled by manual controlled triple pole forward reverse switch and fuse. **[3 Hrs.]**

Sheet 2. Draw connection diagrams for 3-phase, 5 hp 380v delta connected squirrel age induction motor controlled by a star/delta rotary switch and fuses. **[3 Hrs.]**

Sheet 3. Draw wiring layout and connection diagram for water pump installation using 3-phase, 3hp squirrel cage induction motor, DOL starter master ON/OFF rotary switch, float switch for underground and overhead tank **[3 Hrs.]**

Sheet 4. Draw connection and control diagram for 3-phase, 3hp 380 star connected squirrel cage induction motor with the help of 16-amp electromagnetic contactor, 1 NC, 1NO, 220V/380 V and bi-metal relay, ON/OFF momentary push button station and fuses. **[3 Hrs.]**

Sheet 5. Draw connection and control diagram for 3 –phase, 3hp 380V star connected squirrel cage induction motor controlled with the help of 16amp electromagnetic contactor, 1 NC, 1 NO, 220/380V and bi-metal relay forward OFF reverse push button station and fuses. **[3 Hrs.]**

Sheet 6. 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. **[3 Hrs.]**

Sheet 7. 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 breaker. **[3 Hrs.]**

Sheet 8. Draw circuit diagram showing the winding and connections of a 3–phase delta/star 11kv/380Vstep down distribution transformer with 5 tapping on H.V. side and KWH meter with CT, PT. **[4 Hrs.]**

Sheet 9. Draw circuit diagram of a 3-phase, 380V brushless alternator showing the winding connections and Auto manual excitation system. **[3 Hrs.]**

Sheet 10. Draw connection diagram for 3 phase 4 K.W parallel connected 2 heating rods which is control by a digital temperature controller with a help of thermocouple sensor and a contractor as a switch device. **[3 Hrs.]**

Sheet 11. Draw connection diagram for 3 phase Auto / Manual change over panel for generator and NEA (mains) supply with the help of MCCB, power contractors, time delay relays, Indicators, push button switches and switching relays for 200 Amperes Load. **[3 Hrs.]**

Sheet 12. Draw winding diagram of induction motor stator for 24 slots 3-phase, single layer, 2- pole **[4 Hrs.]**

Sheet 13. Draw winding diagram of induction motor stator for 24 slots 3-phase winding 4-poles. **[4 Hrs.]**

Sheet 14. Draw the section view of three phase transformers. **[3 Hrs.]**

References:

1. A.K. Sawhney, A course in'' Electrical Machine Design'', Dhanpat Rai & Co, India, 2016
2. Lionel B. Roe, '' Practices and procedure of industrial electrical Design'' McGraw-Hill, New work,1972.
3. S.L. Bhatia, Hand book of electrical engineering, Khana publishers,india ,2016
4. Surjit Singh, Electrical Engineering Drawing (Part-II), S.K. katariya & Sons, India, 2018

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:

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.

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

Power Stations

EG2208EE

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

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

Tutorial: hour/week

Practical: hours/week

Lab: hours/week

Course Description:

The course deals with the characteristics, features and classifications of electrical power stations.

Course Objectives:

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

1. Explain various power system components
2. Describe various power generating sources and their operating features
3. Diagnose different Excitation systems and AVR used in alternators
4. Illustrate bus bar arrangements at substations

Course Contents:

Theory

Unit 1. Introduction to Power System [4 Hrs.]

1.1. Historical background of electricity generation (international and Nepalese scenario), early electrical system and voltage level

1.2. Schematic layout modern power system: generation, substation, transmission, distribution units

1.3. Need of voltage transformation

1.4. Significance of standard frequency used in A.C. system

Unit 2. Generation of Electrical Energy [7 Hrs.]

2.1. Advantage of Electrical energy in comparison with other form of energy

2.2. Type of generations: base load plant, peak load plant, renewable power plant

2.3. Typical layout for converting an energy into electrical energy

2.4. Sources of energy to be converted into electrical energy

- 2.4.1. Hydro energy to electrical energy
- 2.4.2. Thermal energy to electrical energy
- 2.4.3. Renewable energy sources

2.5. Economic of power generation: load factor, plant capacity factor, plant utilization factor, reserves capacity.

Unit 3. Power Plants [20 Hrs.]

3.1. Types of power plants

3.2. Diesel power plant

- 3.2.1. Working principle and plant layout
- 3.2.2. Component and accessories
- 3.2.3. Manual and automatic starting
- 3.2.4. Operation and maintenance features

3.2.5. Applications

3.3. Hydro power plant
- 3.3.1. Working principle and plant layout
- 3.3.2. Dam, reservoir, forbay, spillway power cannel, tunnel, surge tank, penstock and other accessories
- 3.3.3. Turbines and their classifications
- 3.3.4. Sitting and sizing concept
- 3.3.5. History of hydro power plant in Nepal

3.4. Thermal power plant
- 3.4.1. Basic working principle and plant layout
- 3.4.2. Component and accessories
- 3.4.3. Operation and maintenance features
- 3.4.4. Applications

Unit 4. Transmission and Distribution system [6 Hrs.]

4.1. Transmission System:
- 4.1.1. Introduction, necessity of Transmission System
- 4.1.2. Transmission Layout, voltage level, insulation, right of way, conductor spacing
- 4.1.3. A.C. and D.C applications: introduction and comparison
- 4.1.4. Transmission system in Nepalese context

4.2. Distribution system
- 4.2.1. Introduction, necessity of Distribution System
- 4.2.2. Distribution Layout, voltage level
- 4.2.3. Distribution system in Nepalese context

Unit 5. Major accessories in power plants [8 Hrs.]

5.1. Excitation system
- 5.1.1. D.C. excitation system
- 5.1.2. A.C. excitation system
- 5.1.3. brushless excitation system

5.2. Automatic Voltage regulator construction and operation

5.3. Locations Brief description of switch yard; Bus Bars, Circuit breakers, lighting arrestors

Unit 6. Substations [15 Hrs.]

6.1. Introduction to switchyard

6.2. Necessity of substations

6.3. Substation layouts, incoming and outgoing line arrangements

6.4. Grid substations and distribution substations

6.5. Major equipment at substations

6.6. Selection of transformers based on applications

6.7. Fault limiting reactors

6.8. Circuit breakers, isolators, Lighting arrestors and other accessories

6.9. Bus bar arrangement
- 6.9.1. Single bus bar

6.9.2. Duplicate bus bars
6.9.3. Ring main bus bars
6.9.4. Sectionalization of bus bars

6.10. Communication system telephone, basic concept of PLCC and SCADA system

6.11. Switching stations

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	Introduction to Power System	4	5
2	Generation of Electrical Energy	7	9
3	Power Plants	20	27
4	Transmission and Distribution system	6	8
5	Major accessories in power plants	8	11
6	Substations	15	20
	Total	**60**	**80**

* There could be minor deviation in mark distribution.

References:

1. M.L. Soni, P.V. Gupta, U.S. Bhtnagar& A Chkrabarti, “A text Book on Power System Engineering”,Dhanpat Rai & Co., India
2. Deshpande, “Elements of Electrical Power Station Design”, Pitman & Sons

Third Year/ First Part

S.N.	Course Code	Subject
1	EG3101EE	Switchgear and Protection
2	EG3102EE	Power Electronics
3	EG3103EE	Electrical Machines II
4	EG3104EE	Electrical Design and Estimation
5	EG3105EE	Utilization of Electrical Energy
6	EG3106EE	Fundamentals of Control System
7	EG3107EE	Electrical Repair and Maintenance I
8	EG3108EE	Project 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 Objective:

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:

1. A. Chakrabarti, "Fundamentals of Power Electronic and Drives" Dhanpat Rai and Co., 2002.
2. 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.

Electrical Design and Estimation

EG3104EE

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

Course Description:
This course deals with general principles light and power circuit design consideration of electrical installation design of illumination scheme overhead and underground distribution systems and substations.

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

1. Design estimating and costing of electrical installation for residential, commercial and industrial buildings
2. Explain various types of wiring system
3. Select wiring material and accessories
4. State types of protections of electrical installation

Course Contents:

Theory

Unit 1. General Principles [8 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. Earthing [6 Hrs.]

2.1. Earthing: Types of earthing and its application
2.2. Types of earthing equipment
2.3. Concept of 3-pin plug for high rating equipment
2.4. Substation earthing: safe value of current through human body, soil resistivity, touch and step potential, grounding mat
2.5. Various types of electrodes used for earthing
2.6. Overvoltage: Cause and protection, Overvoltage due to lighting, LA
2.7. Concept of instruments used for resistance measurement

Unit 3. Design, estimation and costing Consideration of Electrical Installation in buildings and industries. [15 Hrs.]

3.1. Electric supply system: single phase two wire and three phase four wire systems.
3.2. Protection of electrical installation against overload short circuit and earth fault
3.3. General requirement of electrical installation

3.3.1. Electricity rules
3.3.2. Testing of installation
3.3.3. Neutral and earth wire
3.3.4. Service connections
3.3.5. Sub-circuits
3.3.6. Location of outlets, control switches, MDB and SDB

3.4. Design and location of MDB and SDB
3.5. Design of lighting and power sub circuits
3.6. Guidelines for installation of fittings
3.7. Load assessment
3.8. Selection of cable size, wires and permissible voltage drop.
3.9. Design electric circuits with and with-out relays
3.10. Design and estimation for domestic and industrial wiring
3.11. Procedure and steps for domestic and industrial wiring estimation
3.12. Modern trends in electrical wiring-MCB, ELCB, RCCB
3.13. Schematic (layout) and wiring diagram

Unit 4. Estimating and Costing of Overhead and Underground Distribution Lines [8 Hrs.]

4.1. Introduction
4.2. Supports for overhead distribution lines
4.3. Estimating and costing for 440 volts, 3 phase ¾ wire overhead distribution line
4.4. Distribution lines materials used.
4.5. Poles and stay wires
4.6. Selection of underground cables

Unit 5. Estimating and Costing of Distribution Substations [8 Hrs.]

5.1. Introduction.
5.2. Outdoor substation pole mounted and pad type
5.3. Indoor substation floor mounted types.
5.4. Bill of Quantity for indoor and outdoor substation

Practical: [30 Hrs.]

Sheet 1. Draw the electrical symbols and standards
Sheet 2. Layout the system distribution of electricity
Sheet 3. Layout the various system of wiring
Sheet 4. Design electrical installation for residential and commercial building
4.1. Residential Building
4.2. Commercial Building
Sheet 5. Prepare a tender for any one of the following:
5.1. Domestic and Industrial Installation
5.2. Distribution, Transmission Line, Service line and Meter Connection
5.3. Repair and maintenance of any electrical equipment

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	General Principles	8	14

2	Earthing	6	11
3	Design, estimation and costing Consideration of Electrical Installation in buildings and industries.	15	27
4	Estimating and Costing of Overhead and Underground Distribution Lines	8	14
5	Estimating and Costing of Distribution Substations	8	14
	Total	**45**	**80**

* There could be minor deviation in mark distribution.

References:

1. Gupta, J.B. (2021). *Electrical Installation Estimating & Costing* (9th ed.). S.K. Kataria & Sons.
2. Roe, L.B. (1972). *Practices and Procedure of Industrial Electrical Design*. McGraw-Hill.
3. Bhatia, S.L. (2001). *Hand Book of Electrical Engineering.* Khanna Publishers.
4. Gupta, P.V., & Satnam, P.S. (2013). *Substations Design and Equipment.* Dhanpat Rai Publication.
5. Pratap, H. (2017). *Art and Science of Utilization of Electrical Energy*. Dhanpat Rai Publication.

Utilization of Electrical Energy

EG3105EE

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

Course Description:

This course deals with the use of electrical energy for domestic, commercial and industrial sectors.

Course Objectives:

On the completion of this course the student will be able to

1. Describe and design the illumination system as per standard requirements.
2. Explain various lighting services-construction and operation.
3. Select electric drives required for various industrial requirements.
4. Apply the various method of power factor correction.
5. Describe the various tariff schemes adopted in Nepal.

Course Contents:

Theory

Unit 1. Introduction to electrical energy with its application [4 Hrs.]

1.1. Conversion of electrical electricity into useful form: light energy, heat energy, electromechanical energy

1.2. Application of electrical energy in different sectors: domestic, commercial and industrial

Unit 2. Illumination and general lighting system [20 Hrs.]

2.1. Difference between heat & light energy emitted by hot body, wave spectrum, electromagnetic waves, Nature of light

2.2. Terminology of illumination - light, luminous flux, luminous intensity, lumen, candle power, illumination, lux, candela, lamp efficiency, brightness or luminance, Glare, Stroboscopic effect, space-height ratio, utilization factor, maintenance factor, depreciation factor, absorption factor, reflection factor, solid angle, steradian

2.3. Laws of illumination - Law of inverse square law & Lambert's cosine law

2.4. Types of lamp: arc lamp, incandescent lamp, gaseous discharge lamp, LED lamp

2.5. Types of lightning schemes - direct lighting, semi-direct lighting, semi-indirect lighting, indirect lighting, general lighting, factory lighting and street lighting.

2.6. Design of lighting schemes - Illumination level, uniformity of illumination, colour of light shadows, glare, mounting height, spacing of luminaries colour of surrounding walls

2.7. Methods of lighting calculations - watt per square meter method, lumen of light flux method

2.8. Numerical problems

Unit 3. Aerodrome Lighting System [10 Hrs.]

3.1. Basic introduction of AGL System
3.2. Approach Lighting System: Simple Approach Lighting System
3.3. Visual Approach Slope Indicator System: T- VASIS, PAPI
3.4. Runway lights: Definitions and examples, Runway Edge light, Threshold and wing bar lights, Runway End lights, Guard lights, Stopway Lights, Taxiway lights, Turning pad light, Aerodrome beacon light

Unit 4. Selection of Electric Motor [10 Hrs.]

4.1. Factors governing selection of electric motors.
4.2. Nature of electric supply
4.3. Types of drives & their choice based on the load
4.4. Electric braking
4.5. Choice of rating of motors
4.6. Types of motor used in industrial drives
4.7. Running & standing characteristics of drives
4.8. Numerical problems

Unit 5. Electric Traction [8 Hrs.]

5.1. Different systems of tractions
5.2. Systems of electric tractions
5.3. Speed-time curves for a traction system
5.4. General features of traction motors

Unit 6. Electrical load and tariff [8 Hrs.]

6.1. Electrical load and tariff: definition and explanation.
6.2. Load characteristics: load curves, load duration curves, load factor, connected load, maximum load, and demand factors, diversity factor etc.
6.3. Types of tariff and applications
  6.3.1. Simple tariff
  6.3.2. flat rate tariff
  6.3.3. block rate tariff
  6.3.4. two-part tariff
  6.3.5. max. demand tariff
  6.3.6. power factor tariff

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	Introduction to electrical energy with its application	4	5
2	Illumination and general lighting system	20	27
3	Aerodrome Lighting System	10	13
4	Selection of Electric Motor	10	13
5	Electric Traction	8	11
6	Electrical load and tariff	8	11
	Total	**60**	**80**

* There could be minor deviation in mark distribution.

References:

1. Taylor, E.Openshaw,(2014), Utilization of Electrical Energy
2. Gupta, J.B., (2012), Utilization of Electrical Power & Traction.
3. Garry, G., A Course in Utilization of Electrical Energy.
4. ICAO Annex-14, Volume I
5. Aerodrome Design Manual: Doc-9157

Fundamental of Control System

EG3106EE

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 introduces the fundamentals of control system components and operation of an automatic control system.

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

1. Explain the working principle of control system and its operating characteristics
2. Describe the use of feedback loops and their applications in real-world control systems
3. Interpret the operational features of mechanical, hydraulic, pneumatic, electrical, and electronic components in control systems.

Course Contents:

Theory

Unit 1. The general concept of control system [4 Hrs.]

1.1. Representation of a control system with a block diagram incorporating actuator, controller, sensor and error detectors
1.2. Recognition of various control system types including open loop, closed loop, analog, and digital
1.3. Working of servomechanisms
1.4. Task of control engineers

Unit 2. Sensors and Transducers [8 Hrs.]

2.1. Function of sensors in a given control system.
2.2. Working of sensors to provide data in control systems.
2.3. Operating characteristics of electric transducers e.g. strain gauges, Potentiometers, tacho-generator, thermocouples
2.4. Pneumatic displacement detectors

Unit 3. Control System Actuators [4 Hrs.]

3.1. Recognition of the applications and operating characteristics of, electric, hydraulic, and pneumatic linear actuators.
3.2. Operating principles of control valves and other components in hydraulic and pneumatic systems.

Unit 4. Control System Switching Devices [6 Hrs.]

4.1. Operating principles
4.2. Applications for, relays, transistors, rectifiers, triacs and other switching devices.
4.3. Operational Amplifier and related signal conditioning circuits in control systems.

Unit 5. Controllers **[6 Hrs.]**

5.1. Necessity and functions of a controller in control system
5.2. Physical interpretation of lead lag networks
5.3. Lead lag networks realization by electrical circuits
5.4. Physical components for an industrial PID controller
5.5. PID controllers with operational amplifiers
5.6. Basic understanding of the working of Pneumatic and hydraulic controllers

Unit 6. Relay Logic and PLCs **[8 Hrs.]**

6.1. PLC: Introduction, working and advantages over relay logics
6.2. Interpretation of ladder logic diagrams.
6.3. Working of Analog and digital control circuits
6.4. Tuning a process control system.

Unit 7. AC, DC and Stepper Motors in Control Systems **[9 Hrs.]**

7.1. Review of AC Induction and DC motors operating principle.
7.2. Working of an AC and DC motor for control systems.
7.3. Armature control and field control DC motors
7.4. Permanent magnet excited DC motors
7.5. Working of stepper motors and their driver circuit

Practical: **[30 Hrs.]**

Lab 1. Demonstrate switching characteristics of Transistor and Operational Amplifier circuits
Lab 2. Demonstrate for ON/OFF Temperature Control Using thermo-couple as sensor and operational amplifier as control switch
Lab 3. Construct PID controller circuits using Operational Amplifier
Lab 4. Close loop Speed Control of DC servomotor with Tacho-generator as sensor
Lab 5. Demonstrate for Pneumatic PID controllers
Lab 6. Interpret the PLC logic and perform basic programming in PLC
Lab 7. Demonstrate for a process control system

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	The general concept of control system	4	7
2	Sensors and Transducers	8	14
3	Control System Actuators	4	7
4	Control System Switching Devices	6	11
5	Controllers	6	11
6	Relay Logic and PLCs	8	14
7	AC, DC and Stepper Motors in Control Systems	9	16
	Total	**45**	**80**

* There could be minor deviation in mark distribution.

References:

1. Mahalanabis, A.K. (1982). *Introductory System Engineering*. India: Wiley eastern Limited.

2. Brayan, G.T. *Control system for technicians*. Great Britain: Hodder and Stoughton Educational.
3. Meyer, L.A. *Control System Basics for HVAC Technicians. ISBN*: 41-0-88069-036-2. Lama Books.

Electrical Repair and Maintenance I

EG3107EE

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 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

Course Contents:

Theory

Unit 1. Automatic Electric iron **[1 Hrs.]**
- 1.1. Operating principle
- 1.2. Circuit diagram and list of parts of Automatic iron
- 1.3. Definition and purposes of repair and maintenance
- 1.4. Review of continuity test, body leakage test in brief

Unit 2. Fan Heater (Room heater) **[1 Hrs.]**
- 2.1. Introduction of Fan and Heater
- 2.2. Circuit diagram and listing the components of fan heater

Unit 3. Electric Kettle **[1 Hrs.]**
- 3.1. Circuit diagram of electric kettle and listing its' parts

Unit 4. Toaster **[1 Hrs.]**
- 4.1. Circuit diagram and its' components
- 4.2. Introduction to latching device and Thermostat/ Timer

Unit 5. Rice Cooker **[1 Hrs.]**
- 5.1. Circuit diagram and listing its' components
- 5.2. Brief theory on Thermal fuse, magnetic switch, Bi-metallic thermostatic switch ON/OFF switch and indicator cooking element, warmer element

Unit 6. Grinder/mixer/ juicer and dryer **[1 Hrs.]**
- 6.1. Introduction to Grinder/mixer/ juicer and dryer
- 6.2. Circuit diagram and listing its' components
- 6.3. Review of applicable motor (if any) on these electrical appliances

Unit 7. Geyser **[1 Hrs.]**
- 7.1. Introduction to Geyser

7.2. Circuit diagram and listing the components of geyser
7.3. Brief theory on earth and its' testing

Unit 8. Refrigerator and air conditioner [1 Hrs.]

8.1. Introduction to refrigerator and air conditioner
8.2. Lay out diagram and its components
8.3. Assemble and disassemble
8.4. Brief review on centrifugal switch, relays- fuses- thermostat door switch, defrosting system, and timer

Unit 9. Induction Stove [1 Hrs.]

9.1. Introduction to induction stove and its' principle.
9.2. Listing the components and draw the circuit diagram,
9.3. Theory on continuity body leakage and its' important in brief.

Unit 10. Microwave oven (MWO) [2 Hrs.]

10.1. Introduction to oven
10.2. Basic working principle of circuit and block description of Microwave oven
10.3. Identification of parts and their working
10.4. MWO heating /cooling concept
10.5. MWO safe utensils and safety precaution
10.6. Basic fault finding and solving ideas

Unit 11. Volt - guard [1 Hrs.]

11.1. Transformer, spike suppression, electronic components, low-high cut system, relay unit, continuity of components and body leakage

Unit 12. Auto-Transformer [1 Hrs.]

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

Unit 13. Battery Charger [1 Hrs.]

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

Unit 14. Water Pump [1 Hrs.]

14.1. Principle of water pump set (3-phase and single phase)

14.2. 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

14.3. 3 phase winding Y - Δ connection, Y - Δ starter – phase sequence, continuity – body leakage test

Practical: [45 Hrs.]

Practical 1. Repair and maintain of automatic electric iron. [3 Hrs.]

1.1 Disassemble automatic electric iron.

1.2 Test switches, heating element, plug leads, thermostat, ceramic glass (if any) by using multimeter and visual inspection.
1.3 Perform maintenance and replace (if any).
1.4 Assemble all components
1.5 Conduct final test.

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

1.1 Disassemble Fan Heater (Room heater).
1.2 Test 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.
1.3 Replace (if any).
1.4 Assemble all components.
1.5 Conduct final test.

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

3.1 Disassemble electric kettle.
3.2 Test 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 Replace (if any).
3.4 Assemble all components.
3.5 Conduct final test.

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

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

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

5.1 Disassemble rice cooker.
5.2 Test 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 Replace (if any).
5.4 Assemble all components.
5.5 Conduct final test.

Practical 6. Repair maintenance of Grinder/mixer/ juicer and dryer [4 Hrs.]

6.1 Disassemble Grinder/mixer/ juicer and dryer.
6.2 Test 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 Replace (if any).
6.4 Assemble all components.
6.5 Conduct final test.

Practical 7. Repair and maintenance of Geyser [3 Hrs.]

1.1 Disassemble Geyser.
1.2 Test heating element, switches, water flow switch, power connection and options (like temperature sensors), indicators by using multimeter and visual inspection.
1.3 Replace (if any).
1.4 Assemble all components.
1.5 Conduct final test.

Practical 8. Repair maintenance of Refrigerator and air conditioner [4 Hrs.]

8.1 Disassemble Refrigerator and air conditioner.
8.2 Test 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.
8.3 Replace (if any).
8.4 Assemble all components.
8.5 Conduct final test.

Practical 9. Repair and maintenance of Induction Stove [3 Hrs.]

9.1 Disassemble Induction Stove.
9.2 Test 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.
9.3 Replace (if any).
9.4 Assemble all components.
9.5 Conduct final test.

Practical 10. Repair and maintenance of Microwave oven (MWO) [4 Hrs.]

10.1 Disassemble Microwave oven (MWO).
10.2 Test 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.
10.3 Replace (if any).
10.4 Assemble all components.
10.5 Conduct final test.

Practical 11. Repair maintenance of Volt - guard [3 Hrs.]

11.1 Disassemble Volt – guard.
11.2 Test 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.
11.3 Replace (if any).
11.4 Assemble all components.
11.5 Conduct final test.

Practical 12. Repair maintenance of Auto-Transformer [3 Hrs.]

12.1 Disassemble Auto- Transformer.

12.2 Test 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.

12.3 Replace (if any).

12.4 Assemble all components.

12.5 Conduct final test.

Practical 13. Repair and maintenance of Battery Charger [3 Hrs.]

13.1 Disassemble Battery charger.

13.2 Test parts-Transformer, Electronic circuit, rectifiers-filter control, hydrometer power connection and indicators by using multimeter and visual inspection.

13.3 Replace (if any).

13.4 Assemble all components.

13.5 Conduct final test.

Practical 14. Repair and maintenance of Water Pump [3 Hrs.]

14.1 Disassemble water pump.

14.2 Test the 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.

14.3 Replace (if any).

14.4 Assemble all components.

14.5 Conduct final test.

References:

1. Bertoldi, P., Ricci, A., & de Almeida, A. (2001). "*Energy Efficiency in household appliances and lighting",* Springer Science & Business Media.
2. Electrical Motor repair - Robert Rosenberg
3. Electrical trade theory - CIMI Madras
4. Manufacturer's catalogue and repair manual

Project I

EG3108EE

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:

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

1. Build up the fabrication skill of electrical system.

Course Contents:

1. **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
   - Any other topics related to electrical engineering approved by the department

2. **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.

3. **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 of ***six*** students shall select a project. Each project shall be supervised by a teacher from the department.

Final Evaluation Scheme

S.N.	Evaluation Criteria	Marks Distribution	Total Marks
1	Report Evaluation	Report Writing Format (6)	12
		Content of Report (6)	
2	Project Evaluation	Content of Project (14)	20
		Project Demonstration (6)	
3	Project Presentation	Presentation Skill (4)	8
		Presentation Dress-up (4)	
	Total		**40**

Third Year/Second Part

S.N.	Course Code	Subject
1	EG3201EE	Electrical Energy Audit
2	EG3202EE	Project II
3	EG3203EE	Power System Operation and Maintenance
4	EG3204EE	Electrical Repair and Maintenance II
5	EG3205EE	Industrial Attachment
6	EG3201MG	Entrepreneurship Development
7	EG3206EE	Transmission and Distribution of Electrical Power
8		Elective
	EG3207EE.1	a) Micro Hydro Power
	EG3207EE.2	b) Instrumentation System
	EG3207EE.3	d) Renewable Energy Technology

Electrical Energy Audit

EG3201EE

Year: III **Total: 4 hours /week**
Part: II **Lecture: 3 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. Power factor correction.
3. Improving lighting system.
4. Efficient operation of process equipment

Course Contents:

Theory

Unit 1. Electrical energy **[3 Hrs.]**

1.1. Introduction
1.2. Electrical energy in Nepal.
  1.2.1. The growth of consumption.
  1.2.2. Energy audit
  1.2.3. Preliminary energy audit
  1.2.4. Electrical energy conservation: The national prospective

Unit 2. Energy Audit Technique **[4 Hrs.]**

2.1. Familiarization of Industry
2.2. Organization of the field survey
2.3. Identification of conservation opportunities
2.4. Energy audit report
  2.4.1. Purpose
  2.4.2. Content
  2.4.3. Analysis

Unit 3. Electrical Energy Survey **[4 Hrs.]**

3.1. Electricity conservation program
  3.1.1. Electricity bill
  3.1.2. Electricity tariffs
  3.1.3. Analysis of electric bill
  3.1.4. Collecting historical data.
3.2. Monitor, measure and record electricity consumption and demand.
3.3. Instruments use for electrical energy survey e.g. ammeter, voltmeter, wattmeter, power factor meter, power analyzer and lux meter.

Unit 4. Plant Electrical Distribution System [8 Hrs.]

4.1. Typical bus system:
- 4.1.1. Simple radial single bus system
- 4.1.2. Double bus system
- 4.1.3. Sectionalized and special bus system

4.2. Voltage Levels and Wiring System

4.3. Conductor Size
- 4.3.1. Energy losses in conductor
- 4.3.2. Optimum conductor size

4.4. Transformer
- 4.4.1. Transformer losses
- 4.4.2. Transformer selection and related numerical.

4.5. Design of new plant distribution system

Unit 5. Power Factor [7 Hrs.]

5.1. Power factor fundamentals

5.2. Causes of low power factor

5.3. Most Economical power factors

5.4. Leading and lagging power factor and kVAr flow

5.5. Effects of low power factor and benefits of its improvement
- 5.5.1. System capacity
- 5.5.2. Capital cost for new system
- 5.5.3. Distribution system loss

5.6. Power factor correction
- 5.6.1. Individual compensation
- 5.6.2. Group compensation
- 5.6.3. Central compensation
- 5.6.4. Synchronous condenser

5.7. Related numerical problems

Unit 6. Load Management [5 Hrs.]

6.1. Maximum demand
- 6.1.1. Measurement of maximum demand
- 6.1.2. Demand charge
- 6.1.3. Cost saving from demand control

6.2. Analysis of potential for demand control
- 6.2.1. Load factor
- 6.2.2. Load curve or demand profile
- 6.2.3. Identification of load

6.3. Methods of demand control
- 6.3.1. Manual demand control (load shedding and monitoring)
- 6.3.2. Automatic demand control

Unit 7. Electric Motors [7 Hrs.]

7.1. Motor efficiency and motor losses

7.1.1. Motor losses: stator and rotor losses, iron or magnetic core losses, friction and wind age losses, stray load losses.

7.2. Standard motor efficiencies.

7.3. Factor affecting electric motor efficiency

7.3.1. Motor size

7.3.2. Motor load

7.3.3. Motor selection and sizing

7.3.4. Motor maintenance

7.3.5. Motor rewinding

7.4. High efficiency motors.

7.5. Numerical related to energy conservation in motors

Unit 8. Lighting [5 Hrs.]

8.1. Review of Lighting sources

8.1.1. Incandescent lamp, Fluorescent lamp, LED lamp, High intensity discharge lamp, Mercury vapour lamp, Metal halide lamp (metal arc lamp) , High/low pressure sodium vapor lamp

8.1.2. Comparison of different types of light source

8.2. Ballasts

8.3. Energy conservation opportunities in lighting system

8.3.1. Turns off lights (time clocks and photo cells)

8.3.2. Reduce light levels

8.3.3. Use daylight to reduce artificial light

8.3.4. Replace inefficient light source by efficient light source

8.3.5. Clean and maintenance of lamp

8.3.6. Use light control equipment, reflector, electronic ballasts, occupancy sensor

8.4. Numerical related to energy conservation in lighting

Unit 9. Energy saving opportunities [2 Hrs.]

9.1. Electrical system

9.1.1. Sub- station and transformer

9.1.2. Load management and power factor improvement

9.1.3. Distribution system

9.2. Electric Drive

9.2.1. Check list for motors

9.3. Lighting system

9.3.1. Checklist of lighting system

9.3.2. Management of lighting system

Lab/Practical: [15 Hrs.]

1. Visit an industry and prepare single line diagram of electric distribution system. Prepare a report and present.
2. Perform a study of energy conservation in lighting system. Calculate and recommend the suitable techniques for energy conservation.
3. Perform a study of energy conservation in electromechanical system. Calculate and recommend the suitable techniques for energy conservation.

4. Perform economic analysis of energy system management of any one (lighting or motoring system)
5. Group presentation.

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	Electrical Energy	3	5
2	Energy Audit Technique	4	7
3	Electrical Energy Survey	4	7
4	Plant Electrical Distribution System	8	15
5	Power Factor	7	12
6	Load Management	5	9
7	Electric Motors	7	12
8	Lighting	5	9
9	Energy Saving Opportunities	2	4
	Total	**45**	**80**

* There could be minor deviation in mark distribution.

References:

1. Gupta, J.B. (2020). Utilization of Electric power & Electric Traction (10^{th} ed.). S.K. Katariya & Sons, India.
2. Mehta, V.K. & Rohit Mehta (2018). Principles of Power System. S. Chand, India.
3. Singh, Tarlok (2010). Installation Commissioning & Maintenance of Electrical Equipment. S.K. Katariya & Sons, India.
4. A course on "Principles and Practices of Energy Conservation System, prepared for 'Office of Energy Efficiency Services/Ministry of Industry, S.L. Nakarmi, IOE
5. General aspects of Energy Management and Energy Audit volume-I, Bureau of Energy Efficiency, Ministry of power, Govt of India.

Project II

EG3202EE

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 contents. 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:

1. Develop the self-capability of students to design, analyze, fabricate and testing of electrical system and devices.

Course Contents:

1. 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
- Any other topics related to electrical engineering approved by the department

2. 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.

3. **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 of ***four*** students shall select a project. Each project shall be supervised by a teacher from the department.

Final Evaluation Scheme

S.N.	Evaluation Criteria	Marks Distribution	Total Marks
1	Report Evaluation	Report Writing Format (9)	18
		Content of Report (9)	
2	Project Evaluation	Content of Project (21)	30
		Project Demonstration (9)	
3	Project Presentation	Presentation Skill (6)	12
		Presentation Dress-up (6)	
	Total		**60**

Power System Operation and Maintenance

EG3203EE

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

Course Description:
This course deals with the operation of small hydroelectric power plant, diesel power plant, solar PV power plant and substation equipment. It also deals with high voltage testing, fault location of cables and maintenance of power plant.

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

1. Introduce small hydro power plant, diesel power plant and solar PV power plant
2. Operate small hydro power plants, substations, diesel power plants and solar PV power plant
3. Perform routine inspection and simple maintenance of small hydro power plant and diesel power plant land H.V. testing, cable fault locating.

Course Contents:

Theory

Unit 1. Deterioration and Maintenance [6 Hrs.]

1.1. Deterioration: causes of deterioration of power plant (moisture, contamination, corrosion, mechanical stress, electrical faults, and system surges, overheating).
1.2. Maintenance: Need of regular of maintenance, types of maintenance: routine, preventive and breakdown maintenance. Factor determining the types of maintenance, maintenance planning and record keeping.
1.3. Listing routine maintenance task- daily, weekly, fortnightly, monthly, quarterly, yearly, number of inspections per period, charts.

Unit 2. Operation of Small Hydro Power Plant [4 Hrs.]

2.1. Small hydro-electric power schemes, review of main civil, hydraulic, mechanical and electrical components of typical small hydro power plant.
2.2. Duties of the operator in charge of a small hydroelectric power plant. Typical operational activities in normal and emergency (abnormal) conditions.
2.3. Technical details and operating characteristics of electronic load controller. Operation of mechanical tripping devices and their effects.
2.4. Technical details of generator, voltage and frequency control. Earthing and protective system.
2.5. Synchronizing scheme, plant operation in isolated, parallel and interconnected.

Unit 3. Routine Maintenance and Inspection of Small Hydro-electric Power plant [8 Hrs.]

3.1. Principle of preventive maintenance, routine maintenance and inspection, safety precaution for maintenance, plant record keeping.

3.2. Typical routine maintenance and inspection for a small hydro power scheme
  3.2.1. Civil work and pipe line
  3.2.2. Turbine and hydraulic equipment
  3.2.3. Generator and electrical equipment
3.3. Lifting and moving heavy equipment. Safe working load and handling of equipment
3.4. Inspection and maintenance of lifting and moving devices and record keeping.
3.5. Electrical equipment insulating oil: - application cause of deterioration and failure of electrical equipment. Testing, reconditioning and handling of insulating oil.

Unit 4. Operation of substation Equipment [8 Hrs.]

4.1. Working with high voltage equipment operational rules and safety regulations, Definitions: Official In charge, Authorized Person, Working Party, High voltage Zone, Working clearance etc.
4.2. Inspection and explanation of sub-station system, system components and methods of operation, Protection system of substation, tripping and alarm sequences
4.3. Receiving and transmitting operational messages by fiber optic, microwave, radio system and WAN, reporting.
4.4. Preparation of switching programs for maintenance
  4.4.1. Main transformers and isolators
  4.4.2. Feeders and cables
4.5. Operating principle of voltage regulating relay, on-load tap changer on main transformer, capacitor banks and reactors.
4.6. Log book keeping of electrical parameters.

Unit 5. High Voltage Testing and Fault Location [9 Hrs.]

5.1. Pressure testing of H.V. equipment after maintenance, objectives, and tables of test voltage for main equipment.
5.2. High voltage cable test set: description and specification, explanation of components and control panel, method of operation.
5.3. High voltage testing safety rules, test controller and isolation of equipment.
5.4. Types of faults on H.V. cables cause of faults, fault type diagnosis procedures, cable records/data, and routine inspection.
5.5. Fault location related to fault types, principles of operation.
5.6. Detail procedure for application of the Murray Loop Test for cable fault location

Unit 6. Operation and Maintenance of Diesel Power Plant [6 Hrs.]

6.1. Operation of diesel power plant.
6.2. General maintenance: changing engine oil, oil filter, cleaning air filter. Valve adjustments, coolant changing, battery and starter motor servicing, adjustment of fuel pump and injectors.
6.3. Inspection and maintenance schedules.

Unit 7. Operation and maintenance of Solar PV Power Plant [4 Hrs.]

7.1. Operation of stand-alone and grid-tied PV plant, concept of hybrid power plant
7.2. General maintenance schedules: PV panel, charge controller, battery, and inverter

Practical: **[45 Hrs.]**

Sheet 1. Visit nearby hydro power plant and observe operation of its various components starting from intake to tailrace.

Sheet 2. Visit substation and prepare its SLD, including its components, bus bar, incoming and outgoing feeders, LA, switch gears, protecting schemes, and transformer.

Sheet 3. Prepare a report for the operation of hydraulic system and turbine.

Sheet 4. Manually operate the Air Circuit Breaker, switches, switch fuses, with switch board dead, replaces fuses, open, isolate and put the ACB into service.

Sheet 5. Follow up operation procedure to run generator up to rated speed. Load the generator:

5.1. isolated mode

5.2. synchronized to the grid

Sheet 6. Visit local NEA substation to note:

6.1. Operator's duties and log book-keeping

6.2. Layout of equipment- indoor and outdoor.

6.3. Provision for safety to public and NEA Staff.

Sheet 7. Take readings of all quantities shown on substation daily log sheet. Record any defects or irregularities.

Sheet 8. 11kV OCB: Open; isolate earth feeder and bus bars. Check the operation of interlock and indicators, fit test plugs, check local and remote control, rack out OCB, lock-off orifices, and isolate PT.

Sheet 9. 11kV switch fuse: open, isolate, earth cable, fit test plug. Change fuse, check fuse trip operation, Lock-off.

Sheet 10. Observe and note down the switching programs.

10.1. on main transformer.

10.2. on feeders and cables.

Sheet 11. Raise and lower the substation voltage using the main transformer OLTC gear. Note down the operation of all controls, remote and local, manual and auto indications.

Sheet 12. Lift and move heavy equipment using a traveling gantry crane, wire rope slings, and nylon web slings.

Sheet 13. Visit nearby solar PV power plant and observe operation of its various components.

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	Deterioration and Maintenance	6	11
2	Operation of Small Hydro Power Plant	4	7
3	Routine Maintenance and Inspection of Small Hydro-electric Power plant	8	14
4	Operation of substation Equipment	8	14
5	High Voltage Testing and Fault Location	9	16
6	Operation and Maintenance of Diesel Power	6	11
7	Operation and maintenance of Solar PV Power Plant	4	7

	Total	**45**	**80**

* There could be minor deviation in mark distribution.

References:

1. Foley, J. H. Electrical Wiring Fundamentals. New York: Gregg.
2. Gupta, J. B. (2009). Electrical Installation Estimating & Costing. SK Kataria and Sons.
3. XIAO, J. K., LIU, N. G., WU, K. L., & DAI, G. S. (2012). Research and Design of Power system Operation and Maintenance Visualization Platform. Electric Power Information Technology, 11.
4. Partab, H. (1970). Art and Science of Utilisation of Electrical Energy. Pritam Surat.
5. Singh, J., & Bhatia, S. L. (1977). Maintenance and Repairs of Earth-moving Equipment at Beas Dam. Water and Energy International.

Electrical Repair and Maintenance II

EG3204EE

Year: III **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 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.
4. Perform repair as per trouble shooting of AC motors, DC motors, and small generators.
5. Perform the cable joint and its' repair maintenance.

Course Contents:

Theory

Unit 1. Repair and maintenance of existing transformer [4 Hrs.]

1.1. Review of repair and maintenance
1.2. Constructional of transformers
1.3. Components of transformer
1.4. Possible fault and its diagnosis idea
1.5. Test – continuity and body leakage
1.6. Coil to coil leakage test

Unit 2. Rewinding a new transformer [2 Hrs.]

2.1. Introduction to rating of transformer,
2.2. Discussion on name plate- required power input voltage and output voltage-frequency and core size,
2.3. Review of Calculation of the size and number of turns of primary and secondary coils,
2.4. Testing of transformer

Unit 3. Maintenance and Repair of motors [3 Hrs.]

3.1. Review of type of motor,
3.2. Construction and probable problem-loose parts,
3.3. Loose connection, broken parts, burn outs,
3.4. Jams.
3.5. Review of No-load test and full load test

Unit 4. Rewinding – stator of motor [4 Hrs.]

4.1. 1-phase motor: Introduction, types and circuit diagram.
4.2. Construction of single-phase motor and review of type of windings.
4.3. Pole pitch: Definitions, slot, teeth, slot insulation, connection of windings.

Unit 5. Underground Cable Joint [2 Hrs.]

5.1. Power cable: Type, construction, selection of Cable shoe- cable head, probable fault in power cable,
5.2. Jointing kit and terminal kit: Introduction, uses
5.3. cable connection,
5.4. cable test,
5.5. Earthing test.

Practical: [45 Hrs.]

1. Repair and maintenance of existing transformer. [8 Hrs.]

1.1. Demonstrate repair and maintenance compliance stated in the standard procedure manual.
1.2. Refer maintenance manual and circuit diagram.
1.3. Ensure all required tools and kits are in good condition.
1.4. Check open, short circuit and body leakage test of two winding, multi winding taped winding and trace the fault.
1.5. Dismantle the core and coils
1.6. Take data of each coil – size of wire and number of turns – compare with the enamel wire data table.
1.7. Clean and assemble (Former) Bobbin
1.8. Rewind coils of appropriate size, material, number of turns and fix tag on beginning and ends
1.9. Assemble core and coils together
1.10. Test – continuity and body leakage, coil to coil leakage test
1.11. Varnes the transformer and dry it, assemble body
1.12. Connect the proper load and run for load test.

2. Rewinding a new transformer [6 Hrs.]

2.1. Find out required power input voltage and output voltage- frequency and core size
2.2. Calculate the size and number of turns of primary and secondary coils
2.3. Prepare bobbin
2.4. Wind coil
2.5. Assemble core
2.6. Test continuity
2.7. Varnes and dry
2.8. Connect supply and load for one hour

3. Maintenance and Repair of motors [12 Hrs.]

3.1. Find out problem from customer Visual inspection for loose parts loose connection, broken parts, burn outs, jams.
3.2. Check continuity and leakage

3.3. Perform No load and full load test
3.4. 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.
3.5. 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.
3.6. 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.

4. Rewinding – stator of motor [14 Hrs.]

4.1. Find out the type of motor- Capacitor start motor, running and starting winding, capacitor centrifugal switch.
4.2. 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.
4.3. Find out no of poles: Pitch of coil – no of slots that each coil spans
4.4. Find out no of turn in each coil
4.5. Find out the Size of wire in each winding
4.6. Find out the connection (series- parallel)
4.7. Find out the Position of windings in relation to other windings
4.8. Conform the type of winding and ensure for procedure - hand, form skein
4.9. Put Slot insulation in both size and kind
4.10. Number of slots
4.11. Stripping the stator
4.12. Magnet wires (enamel wire)
4.13. Slots insulation – insulation class, insulation material, size cuffed ends
4.14. Conduct rewinding- hand rewinding, form winding, skein winding
4.15. Connect the winding – single voltage, double voltage series parallel recognize the connection
4.16. Splice and tape the leads
4.17. Test the new winding
4.18. Bake and varnish

5. Underground Cable Joint [5 Hrs.]

5.1. Identify of single and multicore cable.
5.2. Demonstrate constituents of different types of cable.
5.3. Identify/find out different type of cable base and construction.
5.4. Correct use of various tools necessary for cable joining work.
5.5. Measure of earth resistance and test the continuity of earth conductor earth resistance tester/megger
5.6. Prepare the cable for proper joint if necessary.
5.7. Crimp and insulate each cable.

5.8. Bind the cable and restore the armour strip or wire with applying mesh as possible.
5.9. Re-establish the over sheath.
5.10. Test earth resistance and test the continuity of earth conductor earth resistance tester/megger.

Industrial Attachment

EG3205EE

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

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

Tutorial: hour/week

Practical: 6 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

1. To familiarize with real industrial system
2. To 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 electric sub-station, motor design and maintenance workshop, transformer manufacturing industry and maintenance workshop, circuit breaker manufacturing industry and maintenance workshop, electric power stations on a full-time basis for duration of 90 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 shall consist of the following information:

1. Profile of the industry/plant/workshop and layout diagram of respective organization.
2. Organizational structure and administrative set-up of industry or plant
3. Daily diary maintenance
4. Basic feature of industry or plant
5. Report on selected technological aspect
6. Suggestions for improvement of selected aspect of the problem.

Evaluation Scheme:
The 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

EG3201MG

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 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
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 SME in Nepal

Unit 2. Exploring and developing entrepreneurial competencies [10 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 SMEs in Nepal

Unit 4. Business plan formulation [17 Hrs.]

4.1. Needs and importance of business plan
4.2. Marketing plan
    4.2.1. Description of product or service

4.2.2. Targeted market and customers
4.2.3. Location of business establishment
4.2.4. Estimation of market demand
4.2.5. Competitors analysis
4.2.6. Estimation of market share
4.2.7. Measures for business promotion

4.3. Business operation plan
4.3.1. Process of product or service creation
4.3.2. Required fix assets
4.3.3. Level of capacity utilization
4.3.4. Depreciation & amortization
4.3.5. Estimation office overhead and utilities

4.4. Organizational and human resource plan
4.4.1. Legal status of business
4.4.2. Management structure
4.4.3. Required human resource and cost
4.4.4. Roles and responsibility of staff

4.5. Financial plan
4.5.1. Working capital estimation
4.5.2. Pre-operating expenses
4.5.3. Source of investment and financial costs
4.5.4. Per unit cost of service or product
4.5.5. Unit price and profit/loss estimation of first year

4.6. Business plan appraisal
4.6.1. Return on investment
4.6.2. Breakeven analysis
4.6.3. 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.]

1.1. Collect business information through interaction with successful entrepreneur

Unit 2. Exploring and developing entrepreneurial competencies [2 Hrs.]

2.1. Generate innovative business ideas

Unit 3. Product or service identification and selection [2 Hrs.]

3.1. Analyze business ideas using SWOT method

Unit 4. Business plan formulation [22 Hrs.]

4.1. Prepare marketing plan
4.2. Prepare operation plan
4.3. Prepare organizational and human resource plan
4.4. Prepare financial plan
4.5. Appraise business plan

4.6. Prepare action plan for business startup

Unit 5. Small business management [2 Hrs.]

5.1. Prepare receipt and payment account

5.2. Perform costing and pricing of product and service

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	Introduction to business & entrepreneurship	9	16
2	Exploring and developing entrepreneurial competencies	10	18
3	Business identification and selection	4	7
4	Business plan formulation	17	30
5	Small business management	5	9
	Total	**45**	**80**

* There could be minor deviation in mark distribution.

References:

1. Entrepreneur's Handbook, Technonet Asia, 1981.
2. Khanna S.S., Entrepreneurship Development, S. Chand & Co. New Delhi
3. David H. Holt, Entrepreneurship: New Venture Creation, Prentice Hall India
4. MohantySangramKeshari, Fundamentals of Entrepreneurship, Prentice Hall India

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
4.7 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:

1. V. K. Mehta, Rohit Mehta, (2005), “Principles of Power System”, S. Chand.

2. Dr. B.R. Gupta, (2005), “Power System Analysis and Design”.
3. J.B. Gupta, (2013), “Transmission and Distribution of Electrical Power”, S. K. Kataria and sons.
4. M.L. Soni, P.V. Gupta, U.S. Bhatnagar & A. Chakrabarti, (2011), “A text Book on Power System Engineering”, Dhanpat Rai & Co., India
5. A.S. Pabla, (2010), “Electric Power Distribution”, Tata McGraw-Hill Publishing Company Ltd, India
6. J.J. Burke, (2014) “Power Distribution Engineering Fundamentals & Applications”, Marcel Dekker, Inc., New York.

Micro Hydro Power

(Elective)

EG3207EE.1

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 the Micro Hydro Power (MHP) plant. The main focus of this course is the constructional details and functions of various components of a MHP plant and management, operation and maintenance aspect of MHP plant.

Course Objectives:

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

1. Familiarize with the features of Micro Hydro Power (MHP) plant.
2. Conduct the survey, design, management, operation and maintenance of MHP plant.
3. Explain the basic constructional details, function and operation of various components of an MHP plant such as: civil construction components, electro-mechanical components, protection system, and distribution system.

Course Contents:

Theory

Unit 1. Introduction to Micro Hydro Power [4 Hrs.]

1.1. Classification of hydro power plant by capacity
1.2. Features of Micro Hydro Power (MHP) plant
1.3. Role of MHP plant for rural development
1.4. Historical background and current status of MHP in Nepal

Unit 2. Basic Concept and Civil Construction Works of MHP Plant [6 Hrs.]

2.1. Basic layout of a MHP plant
2.2. Principle of power generation - Definition of head and discharge, Power equation.
2.3. Components of MHP Plant, their constructional details and functions – Weir and intake, Canal, Desilting basin and spillway, Forebay, Penstock, Power house, Tailrace.

Unit 3. Electro-mechanical component of MHP Plant [13 Hrs.]

3.1. Turbines and valves: Types of turbine and their working principle, turbines for MHP plants, types of valve used in MHP plant.
3.2. Synchronous generator: Basic construction and working principle, Excitation system.
3.3. Induction generator: Basic construction and working principle, requirement of excitation capacitor.
3.4. Coupling of turbine and generator - Direct coupling, Belt drive, Flywheel.

3.5. Speed Governing – Hydraulic mechanical governor, Electronic Load Controller (ELC) – Basic principle, types of ELC – AC voltage controller based ELC, DC chopper based ELC, Discrete resistance type ELC.

3.6. Voltage control – AVR for synchronous generator, VAR compensator (Thyristor Switched Capacitor and Fixed Capacitor Thyristor Control Reactor) for induction generator

Unit 4. Survey of MHP Plant and Basic Design Concept [6 Hrs.]

4.1. Basic concept of site selection for MHP Plant

4.2. Measurement of discharge at site – Bucket method, Velocity area method, Weir method, Salt dilution method.

4.3. Measurement of head at site- Using clinometer, using a water-filled tube, Using altimeter

4.4. Power Calculation, selection and sizing of turbine and generator

Unit 5. Protection System for MHP Plant [6 Hrs.]

5.1. Over speed protection

5.2. Over-load and short-circuit protection for generator

5.3. Over voltage and under voltage tripping system

5.4. Earthing for generator neutral and body

5.5. Protection of generator and ELC from lightning strike

5.6. Single-line diagram of control panel with protection devices

Unit 6. Distribution System [4 Hrs.]

6.1. Basic layout of distribution system

6.2. Calculation of conductor size for distribution line

6.3. Poles and insulators for distribution line

6.4. Consumer's connection system

6.5. Voltage regulation of distribution line

Unit 7. Management, Operation and Maintenance of MHP Plant [6 Hrs.]

7.1. Individual ownership management

7.2. Community ownership-based management

7.3. Plant operator – starting up procedure, shutdown procedure, training of operator.

7.4. Regular maintenance of procedure for intake system, canal, desilting basin and spillway, forebay, penstock, turbine, valve, generator.

Practical: [30 Hrs.]

1. Conduct an experimental study on synchronous generator at Lab.
- 1.1. Study of excitation and voltage build-up at no-load.
- 1.2. Operate with purely resistive load.
- 1.3. Operate with inductive load and effect on terminal voltage.

2. Conduct an experimental study on electronic load controller at Lab.

3. Conduct a Field study on an existing MHP plant.

4. Field measurement
- 4.1. Measure flow,

4.2. Conduct head measurement,
4.3. Calculate power,
4.4. Section of turbine and generator.

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	Introduction to Micro Hydro Power	4	7
2	Basic Concept and Civil Construction Works of MHP Plant	6	11
3	Electro-mechanical component of MHP Plant	13	22
4	Survey of MHP Plant and Basic Design Concept	6	11
5	Protection System for MHP Plant	6	11
6	Distribution System	4	7
7	Management, Operation and Maintenance of MHP Plant	6	11
	Total	**45**	**80**

* There could be minor deviation in mark distribution.

References:

1. Adam Harvey, "Micro-Hydro Design Manual – A guide to small-scale water power generation", published by Intermediate Technology Publication, 1993
2. Manual for survey and layout design of private micro-hydro power plants, published by ICIMOD, Kathmandu, Nepal, 1999
3. Maintenance and Repair Manual for private micro-hydro power plants, published by ICIMOD, Kathmandu, Nepal, 1999
4. Operation and Management Manual for private micro-hydro power plants, published by ICIMOD, Kathmandu, Nepal, 1999

Instrumentation System

(Elective)

EG3207EE.2

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 introduces the basic instrumentation techniques: sensors & actuators.

Course Objectives:

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

1. Explain operating characteristics & operating principle of different transducers
2. Apply sensors and actuators in real-world instrumentation
3. Determine set points, and setting limits for variables and signals representing variables.
4. Use different type of Potentiometers.
5. Measure the temperature.

Course Contents:

Theory

Unit 1. Basic concepts **[8 Hrs.]**

1.1. Transducers, Sensors and Actuators
1.2. Basic requirements of a Transducer
1.3. Classification of Transducers
1.4. Selection of Transducers
1.5. Specification, Sensitivity and Accuracy
1.6. Resolution & Range

Unit 2. Measurement of Position and speed **[10 Hrs.]**

2.1. Potentiometers
  2.1.1. Operating principle
  2.1.2. DC potentiometers
  2.1.3. AC potentiometers
2.2. LVDT construction & operating principle
2.3. RVDT construction & operating principle
2.4. Capacitive Transducers
2.5. Hall effect application in displacement measurement
2.6. Tacho-generator
2.7. DC Tacho-generator
2.8. AC Tacho-generator
2.9. Digital Counter principle
2.10. Linear velocity measuring concept

Unit 3. Measurement of Torque, Force & Pressure **[8 Hrs.]**

3.1. Torque measurements
  3.1.1. Strain guage principle
  3.1.2. inductive transducers
  3.1.3. Electronic technique
3.2. Piezoelectric Transducers
  3.2.1. Material
  3.2.2. Construction
  3.2.3. Operating principles
3.3. Applications of Piezoelectric Transducers
3.4. Accelerometers

Unit 4. Measurement of temperature [6 Hrs.]

4.1. Resistance Temperature detector
  4.1.1. Principle
  4.1.2. Construction
  4.1.3. Applications
4.2. Thermistor
  4.2.1. Principle
  4.2.2. Construction
  4.2.3. Applications
4.3. Thermocouple
  4.3.1. Principle
  4.3.2. Construction
  4.3.3. Applications

Unit 5. Miscellaneous Transducers [9 Hrs.]

5.1. Photoconductive cells
5.2. Vacuum measurements
5.3. Pneumatic displacement detectors
5.4. Flow measurements
5.5. Measurements of sound

Unit 6. Signal conditioning circuits [4 Hrs.]

6.1. Operational Amplifier
6.2. Application of Op-Amp in instrumentation

Practical: [30 Hrs.]

1. Verify the resistance transducers for angular or linear position Applications
2. Verify the characteristics of strain gauge transducer.
3. Verify the characteristics of a capacitive transducers.
4. Verify the characteristics of thermocouple
5. Verify the characteristics of a Hall effect transducers
6. Verify the characteristics of a Buzzer
7. Verify the characteristics of a Differential Amplifier

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

1	Basic concepts	8	14
2	Measurement of Position and speed	10	18
3	Measurement of Torque, Force & Pressure	8	14
4	Measurement of temperature	6	11
5	Miscellaneous Transducers	9	16
6	Signal conditioning circuits	4	7
	Total	**45**	**80**

* There could be minor deviation in mark distribution.

References:

1. Gupta J.B. (2008) "A course in Electronic and Electrical Measurements and Instrumentation", S.K. Kataria& Sons, India.
2. Mahalanabis A.K (1982)., "Introductory System Engineering" Wiley eastern Limited, India

Renewable Energy Technology

(Elective)

EG3207EE.3

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 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 **[5 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 **[12 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 [8 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 [8 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 [8 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 [4 Hrs.]

6.1. Introduction

6.2. Advantages of Hybrid Energy
6.3. Wind Solar Hybrid System

Practical: **[30 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	5	9
2	Solar Energy	12	21
3	Hydro-electricity	8	14
4	Biomass	8	14
5	Wind Energy	8	14
6	Hybrid	4	8
	Total	**45**	**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

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