Secondary Level School Curriculum

(Technical and Vocational Stream)

(Grade 9-10)

Electrical Engineering

2078

Government of Nepal

Ministry of Nepal

Curriculum Development Centre

Sanothimi, Bhaktapur

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Preface

Secondary Level Education in Nepal aims to produce skillful healthy citizens familiar with national customs, culture, social heritage and democratic values who can actively take part in the economic development of the country. So, the main aim of this level is to produce skilled manpower who can make special contribution to the country's all-round development, and at the same time, to produce conscious citizens with essential knowledge and skills to be ready for university education. The process of developing and revising school level curricula in Nepal is being continued in line with this objective.

In this connection, in order to bring relevant changes in secondary level curricula as per the recommendations of School Sector Development Plan (SSDP), some subjects, i. e. Plant Science, Animal Science, Computer Engineering, Electrical Engineering and Civil Engineering have been introduced under Technical and Vocational stream. According to this provision, the curricula of these subjects have been prepared, and they are being implemented. Considering the situation that the curricula of these subjects are not easily available at present, they have been published for the wider circulation. This curriculum, revised in 2078 B. S., is one of them.

Revising school level curricula is a continuous process and the role of teachers, parents and scholars is vital in making it more effective in future. Therefore, the Curriculum Development Centre always anticipates constructive suggestions from all the persons concerned.

Curriculum Development Centre
Sanothimi, Bhaktapur

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S.N Subjects Page No.

Course Structure

Grade Nine

Grade Ten

Curriculum Structure

Class 9-10

क्र.सं.	कक्षा ९			कक्षा १०		
	विषय	पाठ्यघण्टा Credit	वर्षिक कार्यघण्टा	विषय	पाठ्यघण्टा Credit	वर्षिक कार्यघण्टा
१	नेपाली	४	१२८	नेपाली	४	१२८
२	अङ्ग्रेजी	३	९६	अङ्ग्रेजी	३	९६
३	गणित	३	९६	गणित	३	९६
४	विज्ञान	३	९६	विज्ञान	३	९६
५	सामाजिक	३	९६	सामाजिक	३	९६
६	Computer Application	४	१२८	Electrical Machine	४	१२८
७	Engineering Drawing	४	१२८	Basic Electronics	४	१२८
८	Basic Electrical Engineering	४	१२८	Industrial Installation and Maintenance	४	१२८
९	Basic Electrical Installation and Workshop Technology	४	१२८	Utilization of Electrical Energy	४	१२८
	जम्मा	३२	१०२४		३२	१०२४

Computer Applications

Grades: 9 Credit hrs: 4 Working hrs: 128

1. Introduction

The computer applications curriculum aims to prepare technically inclined students to be technologically adapt as effective citizens and to function and contribute effectively in an increasingly technologically driven world. The end goal is that students enjoy using computer related technology as an integral part of their lives and as an important tool in helping them to meet their own personal needs and the needs of society.

This curriculum comprises of the contents like principles of programming, fundamentals of C, control flow Statements, functions in C, Arrays in C, Strings in C, Structure and Union in C and Pointers in C. The course itself is of practical nature and the pedagogical approaches in delivering the course should consider the balance between theory and practice. Moreover, it helps the students to build up capacity to identify, gather, manipulate and process information in the context of scientific endeavors including field investigations in various formats on Computer issues.

The curriculum prepared in accordance with National Curriculum Framework is structured in such a way that it incorporates the level-wise competencies, grade-wise leaning outcomes, scope and sequence of contents, suggested practical/project activities, learning facilitation process and assessment strategies to enhance the learning on the subject systematically.

2. Competencies

On completion of the course, the students will have the following competencies:

1. Develop a sense of information technology culture.
2. Develop an awareness of how a computer works and apply the fundamental skills.
3. Gain knowledge about the programming languages.
4. Acquire skills in using application software.
5. Acquire skills in computer networking.

3. Grade-wise Learning Outcomes

S.N.	Content Area	Learning Outcomes
1	Introduction to Computer	1.1. Introduce the concepts of computer. 1.2. Describe the History of computers. 1.3. Describe the Computer system characteristics. 1.4. Describe the Capabilities and limitation of computers. 1.5. Introduce the Types of computers. 1.6. Describe the Generations of computers and its features: 1.7. Identify and explain the Types of PC/Es and their characteristics.
2	Computer System	2.1. Describe the Concept of Computer Organization. 2.2. Identify all hardware parts with CPU of Computer and dismantle them. 2.3. Describe the Basic components of a computer system. 2.4. Describe the Memory. 2.5. Describe the Storage Device. 2.6. Introduce the Input Device. 2.7. Introduce the Characteristics of monitor. 2.8. Describe the Computer Software.
3	Operating System	3.1. Introduce of operating System. 3.2. Classify its types. 3.3. Describe Disk Operating System (DOS). 3.4. Introduce Windows Operating System. 3.5. Introduce Open Sources Operating System.
4	Programming languages	4.1. Introduceprogramming language and identify its levels. 4.2. Describe Compiler, Interpreter and Assembler. 4.3. Write the types of High Level Programming Languages. 4.4. Differentiate between Program and Software.

		4.5. Introduce Program Control Structures. 4.6. Introduce Program Design Tools. 4.7. Introduce QBASIC.
5	Application of Software	5.1. Introduce Word Processing Concept and types. 5.2. Introduce Spreadsheet. 5.3. Introduce Presentation.
6	Computer Networks and Topologies	6.1 Introduce computer networks. 6.2 Describe Mode of Transmissions Flow. 6.3. Describe Communications Channels. 6.4. Introduce Modem. 6.5. Classify types of Network. 6.6. Describe topologies of LAN. 6.7. Introduce Components of LAN. 6.8. Identify the use of Communication in daily life.
7	Internet and Electronic mail (Email)	7.1. Introduce internet. 7.2. Identify the uses of Internet. 7.3. Describe the Concepts of Protocols. 7.4. Describe Web. 7.5. Introduce Search Engine.

4. Scope and Sequence of Contents

S.N.	Content Area	Elaboration of Contents	Hrs.
1.	**Introduction to Computer**	1.1.Concepts of computer. 1.2. History of computers. 1.3. Computer system characteristics 1.4. Capabilities and limitation of computers. 1.5. Types of computers On the basis of data:	

		• Analog • Digital • Hybrid On the basis of size • Micro • Mini • Mainframe and • Super 1.6. Generations of computers and its features: • First • Second • Third • Fourth and • Fifth generation 1.7. Types of PC/Es and their characteristics. • Desktop • Laptop • Notebook • Palmtop • Workstations	7
2.	**Computer System**	2.1. Concept of Computer Organization 2.2. Familiar with all hardware parts with CPU of Computer and dismantle 2.3. Basic components of a computer system – Input, Output, Processor and Storage 2.4. Memory – Primary and Secondary Cache (L1, L2), Buffer, RAM, ROM, PROM, EPROM, EEPROM	14

		2.5. Storage Device – Storage fundamentals - Primary Vs Secondary data Various Storage Devices - Magnetic Tape, Magnetic Disks: Hard Disk and Floppy Disks (Winchester Disk), Optical Disks: CD, VCD, CD-R, CD-RW, DVD, DVD-RW, Blue Ray Disc. Others: Flash drives, SD/MMC Memory cards Physical structure of floppy & hard disk, drive naming conventions in PC. 2.6. Input Device - Keyboard, Mouse, Trackball, Joystick, Digitizing tablet, Scanners, Digital Camera, MICR, OCR, OMR, Bar-code Reader, Voice Recognition, Light pen, Touch Screen. 2.7. Characteristics of monitor-Digital, Analog, Size, Resolution, Refresh Rate, Interlaced/Non Interlaced, Dot Pitch, Video Standard-VGA, SVGA, XGA etc. Printers and types – Impact (Dot matrix printer), Non-impact (Laser printer) 2.8. Computer Software 2.8.1 Definition of software 2.8.2 Necessity of computer software 2.8.2 Types of Software-System Software, Application software.	

3	**Operating System**	3.1. Introduction of operating System 3.1.1 Concept of Operating system 3.1.2 Role of operating system 3.1.3 Function of operating system 3.2. Type-Batch, Single, Multi programming, Multi processing, Multi-tasking, Multi processing, Timesharing, Real time, 3.3. Disk Operating System (DOS) 3.3.1 Introduction to CUI and it's feature 3.3.2 Concept of File and Directory 3.3.3 Concept of Wildcards and Pathname, System Files: Config.sys, IO.sys, MSDOS.sys, autoexec.bat 3.4. Windows Operating System 3.4.1 Introduction to GUI and its feature 3.4.2 Working with a Window Environment and Window Application Program 3.4.2 Manage files and folders with explorer 3.5. Open Sources Operating System 3.5.1 Introduction of Open Sources Operating System 3.5.2 Introduction to Linux, UNIX	8

	Programming languages	4.1. Programming concept 4.1.1 Introduction to programming languages 4.1.2 Low level, Machine, Assembly, High Level languages 4.2. Compiler, Interpreter and Assembler 4.3. List of High Level Programming Languages 4.4. Difference between Program and Software 4.5. Program Control Structures - Sequence, Selection and Iteration. 4.6. Program Design Tools – Algorithm, Flowchart and Pseudo Code 4.7. Introduction to QBASIC 4.7.1 Elements of QBASIC 4.7.2 QBASIC Statements 4.7.2.1 Declaration Statements CONST, DIM, REM 4.7.2.2 Assignment Statements LET, READ, DATA 4.7.2.3 Input/Output Statements INPUT, PRINT, LINE INPUT, INPUT$ 4.7.2.4 Control Statements GOTO IF…. THEN IF…. THEN…….. ELSE IF…. THEN…. ELSEIF……. ELSE SELECT…… CASE…… FOR….. NEXT	6

5	**Application of Software**	5.1. Word Processing Concept, types and uses 5.1.1 Introduce word processing 5.1.2 Word Processor's Interface 5.1.3 Entering and Editing Text 5.1.4 Formatting Text-Characters, Paragraphs and Documents 5.1.5 Working with Special features of Word Processing 5.1.6 Language tools, Tables 5.1.7 WordArt and Charts 5.1.8 Adding Graphics 5.2. Spreadsheet Concept and Use of Spreadsheet 5.2.1 Introduction to spreadsheet 5.2.2. Types of Spreadsheet 5.2.3 Spreadsheet's Interface 5.2.4 Entering Data in a Worksheet 5.2.5 Labels, Values, Dates and Formulas 5.2.6 Editing and Formatting a Worksheet 5.2.7 Relative and Absolute Cell References 5.2.8 Formatting Values, Labels and Cells 5.2.9 Adding Charts 5.2.10 Data Filter and sorting 5.2.11 Working with Special features of spreadsheet 5.2.12 General Functions and Formulas 5.3. Concept of Presentation 5.3.1 Introduction of Program Basics 5.3.2 Presentation Program's Interface 5.3.3 Creating a Presentation 5.3.4 Formatting Slides	16

		5.3.5 Special Features of Presentation Programs – Transition, Animation and Custom Animation 5.3.6 Working with Tables, Graphics, Word ART, Graphs, Organization Charts and Multimedia 5.3.7 Integrating Multiple Data Sources in a Presentation 5.3.8 Presenting Slide Shows	
6	**Computer Networks and Topologies**	6.1 Concept of computer networks 6.1.1 Definition of computer network 6.1.2 Use of computer networks 6.1.3 Advantages of computer networks 6.2 Mode of Transmissions Flow-Simplex, Half Duplex, Full Duplex 6.3. Communications Channels-Twisted, Coaxial, Fiber Optic, Serial and Parallel Communication 6.4. Modem-Working and characteristics 6.6. Types of Network - LAN, WAN, MAN, Internet 6.7. Use of Communication in daily life	7
7	**Internet and Electronic mail (Email)**	7.1 Concept of internet 7.1.1 Introduction of Internet and email 7.1.2 Use of internet 7.2. Advantages/Applications of Internet 7.3. The Web Web Server Web Browser Web Site Domain Name System (DNS) Uniform Resource Locator (URL) 7.4. Search Engine	6
	Total		**64**

5. Suggested Practical and Project Works

Practical and project work is an integral part of technical and vocational subjects. They are carried out to consolidate the practical learning experiences. Some of the suggested practical and project work activities of this subject are mentioned below. As these are the basic and fundamental practical and project works, the teacher can adapt or introduce more relevant to their context and students' needs.

S.N.	Grade 9		
	Content Area	**Some Suggested Practical Activities**	**Hrs.**
2	Computer System	2.1. Be familiar with all the hardware parts of a computer within the CPU as well as external hardware. 2.2. Assemble PC. 2.3. Disassemble PC. Access and Change BIOS settings	**8**
3	Operating System	3.1. Execute Simple DOS Commands COPY, REN, DIR, TYPE, CD, MD, BACKUP 3.2. Be familiar with Windows Operating System 3.3. Be familiar with UNIX as well as Linux Operating system 3.4. Learn in installing a Computer System by giving connection and loading System Software and Application Software. 3.5. Install existing operating System.	**14**
4	Programming languages	Be familiar with machine, assembly and high level languages. ➢ Drawing Flow charts and introduce with Qbasic ➢ Execute simple introductory programs in Q Basic	**8**

5	Application of Software	5.1. Create a document in MSWord using proper format. 5.2. Create an Excel Worksheet for generating mark sheet/salary sheet/ balance sheet/ bills/ ledger and so on. 5.3. Design a PowerPoint presentation with not less than 10 slides on any of your interesting topic. 5.4. Perform a project work in MS-Word. 5.5. Perform a project work in MS-Excel. 5.6. Perform a project work in MS-Power Point. **5.7.** Perform a project work in MS-Access.	**16**
6	Computer Networks and Topologies	6.1. Install and Configure Windows NT operating system in a PC. 6.2. Construct Network by connecting one or two computer with a Windows NT Server. Learn the various types of cabling : Straight Through Cable, Cross Cable and Rollover Cable	**12**
7	Internet and Electronic mail (Email)	7.1. Browse Internet using Search Engines like Google.com, Yahoo.com and ask.com for files, pictures, power point presentations etc. Downloading files, EBooks, EContent from Internet. 7.2. Register for new Email address with any free Email provider and send Email using Internet to your friends, parents, teachers etc. 7.3. Configure the network for an Internet server. 7.4. Add / Remove devices using Hardware	**6**

		Wizard. Add and Manage User Profile, Set permission to the users in Windows NT .	
	Total		**64**

6. Learning Facilitation Process

This course intends to provide both theoretical as well as practical knowledge and skills on the subject, thereby, blends with both theoretical and practical facilitation strategies to ensure better learning. In fulfilling the learning outcomes stated in the curriculum, the teacher should use a variety of methods and techniques that fit to the contents. In particular, the following methods, techniques and strategies are used for learning facilitation:

- Demonstration
- Practical Works
- Audio/Visual use from different sources
- Project Works
- Presentation and assignments
- Discussion
- Group works and pair works

7. Student Evaluation

Evaluation is an integral part of learning process. Both formative and summative modes of evaluation are emphasized. Formative evaluation will be conducted so as to provide regular feedback for students, teachers and parents/guardians about how student learning is. Class tests, unit tests, oral question-answer, home assignment etc, are some ways of formative evaluation.

There will be separate evaluation of theoretical and practical learning. Summative evaluation embraces theoretical examination, practical examination and evaluation of research work or innovative work.

(a) Internal Evaluation

Internal evaluation covers 50 Percent weight age. Internal evaluation consists of Practical Activities (Practical works and projects works) (35 Percent), (b) Marks from trimester examinations (10 Percent), and (c) Classroom participation (5 Percent). Practical work should be based on list of activities mentioned in this curriculum. Project works should be based on the mentioned lists or created by teachers. Mark distribution for internal evaluation (practical work and project work) will be as follows:

S.N.	Mani activities	Activities in detail	Percent
1	Participation	Participation in attendance, homework, classwork, project work, practical works etc.	5
2	Practical work	Conduction of practical work activities	15
		Record keeping of practical work activities	3
3	Project work	Conduction of project work activities	10
		Record keeping of project work activities	2
4	Viva	Viva of practical work and project work activities	5
6	Internal exam	First trimester 5 marks and Second trimester 5 marks	10
Total			50

Note:

(i) Practical examination will be conducted in the presence of internal and external supervisors. Evaluation of experiment will focus both the product of work and skills competencies of student in using apparatus.

(ii) Project work assessment is the internal assessment of reports and presentation of their project works either individually or group basis. In case of group presentation, every member of the group should submit a short reflection on the presented report in their own language. Records of project works must be attested by external supervisor.

(b) External Evaluation

There will be an external written examination which covers 50% of the weight. The tool for external evaluation of theoretical learning will be a written examination. Questions for the external examination will be based on the specification grid developed by Curriculum Development Centre. Examination question paper will be developed using various levels of revised Bloom's taxonomy including remembering level, understanding level, application level and higher ability (analyzing, evaluating, creating).

Specification Grid

Grade: 9 Subjects : Computer Applications Time : 2 hrs.

Unit	Content	Credit hrs.	Knowledge and Understand			Application			Higher Ability			Total Question Number			Total Question	Marks Weight			Total Marks
			MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long		MCQ	Short	Long	
1	Introduction to Computer	7	6	2	0	3	2	1	0	1	1	9	5	2	16	9	25	16	5
2	Computer System	14																	12
3	Operating System	8																	6
4	Programming languages	6																	4
5	Application of Software	16																	14
6	Computer Networks and Topologies	7																	5
7	Internet and Electronic mail (Email)	6																	4
	Total	64	6	2	0	3	2	1	0	1	1	9	5	2	16	9	25	16	50

Engineering Drawing

Grades: 9 **Credit hrs: 4** **Working hrs: 128**

1. Introduction

This course is designed to provide knowledge about the engineering drawing, its importance and its application. Thus course provides concept knowledge and skills on basic drafting technique, handling of drawing instruments and materials, geometrical construction of different shapes, line works, lettering and dimensioning, This course is so designed to give basic concept about the projections like orthographic, section, isometric projections, simple intersection of solids, surface development of solid and objects and so on. This course is designed to provide the basic skills of drawing on part of their real work practices.

This curriculum covers a wide variety of contents: an Introduction to drawing, line and geometrical shape, freehand practicing, lettering, practicing the line and circle using drawing instrument, scale, geometrical construction, division, tangent, engineering curves, conic section, dimensioning, orthographic projection, pictorial projection, and projection of points, true length and shape, section, surface development, intersection of two solids and Land measurement /symbol.

The curriculum is prepared in accordance with National Curriculum Framework, 2076 and is structured in such a way that it incorporates the level-wise competencies, grade-wise leaning outcomes, scope and sequence of contents, suggested practical/project activities, learning facilitation process and assessment strategies so as to enhance the learning on the subject systematically.

2. Competencies

On completion of the course, the students shall have the following competencies:

1. Develop basic ideas on engineering drawing
2. Apply of different tools and equipments of drawing
3. Develop general skills on engineering curves and projections
4. Describe intersection of simple objects

5. Predict different geometrical shapes.

3. Grade-wise Learning Outcomes

S.N.	Content Area	Learning Outcomes
1	Introduction to drawing	1.1.Introduce drawing and its types. 1.2Introduce drawing materials. 1.2.1List the uses and functions of drawing materials. 1.2.2Mention Care and proper handling procedure of drawing materials. 1.3.List Drawing tools and their functions. 1.4.Mention care and handling process of drawing tools and equipment. 1.5List the uses and advantages of drawing tools and equipment. 1.6.Introduce the procedure of drawing. 1.7 Introduce freehand practice. 1.8 Introduce lettering and its practices. 1.9 Provide the concept of dimensioning and way of dimensioning.
2	Introduction to geometrical shapes	2.1.Introduce line and its types. 2.2. Draw different types of line. 2.3List the uses and advantages of line. 2.4 Introduce geometrical shape. 2.5Provide concept of Circle and its parts. 2.6. Introduce concept of division and divide lines and circles into number of parts.
3	Scale	3.1. Provide the concept of Scale. 3.2. List types of scale. 3.3. Mention ways to prepare a different types of scale such as:

4	**Tangent**	4.1. Provide concept of Tangent. 4.2 List Types of Tangent and construct them.
5	**Engineering Curves and conic section**	5.1. Provide concept of Curve and conic section. 5.2. List types of Engineering Curves and conic sections. 5.3 Construct different types of Engineering curves and conic sections.
6	**Orthographic Projection**	6.1. Provide concept Projection. 6.2. Introduce Orthographic Projection. 6.3. Describe principle of projection. 6.4. List rules of projection. 6.5. Differentiate of the first angle and third angle projection. 6.6Mention procedure of orthographic projection. 6.7. Construct different types of orthographic projections .Model with flat 6.8. Introduce section. 6.9. List the rules of section. 6.10. List importance of section. 6.11. List the types of sectional planes. 6.12. Construct different types of sectional plane.
7	**Pictorial Projection**	7.1. Introduce Pictorial Projection. 7.2. List types of Pictorial Projection. 7.3. List rules of Pictorial projection. 7.4. Construct different types of Pictorial projections. 7.5Introduceprojection of points.
8	**Surface Development**	8.1. Provide concept of Development. 8.2. Introduce of surface Development. 8.3. Practise methods of surface development.

4. Scope and Sequence of Contents

S.N.	Content Area	Elaboration of Contents	Hrs.
1.	Introduction of drawing	1.1.Introduction to drawing , History and Types of drawing 1.1.1Concept of Engineering drawing. 1.1.2 Classification of Engineering drawing. 1.2Drawing materials : • Drawing sheet (Drawing Paper) A0 to A5 size • Drawing pencil simple to machine attach type • Drawing pens(ink set) • Masking tape (paper tape) • Eraser , Erasing brush • Pencil cutter (simple to table fixture type) • Base paper (card board type) 1.2.1Uses and functions of drawing materials 1.2.2Care and proper handling procedure of drawing materials 1.3.Drawing tools and their functions: • Tee Square plastic / wooden • French Curve • Templates • Drafter • Protractor • Divider • Set square small and large size • Compass Set and Scale 12cm to 30cm • Drawing board B0-B4 size	8

		• Drafting Set normal type 1.4.Care and handling process of drawing tools & Equipment. 1.5Uses and advantages of drawing tools &Equipment . 1.6. Procedure of drawing 1.7 Freehand Practice 1.7.1. Provide the concept of Freehand line 1.7.2. Freehand method to prepare: • practice of horizontal line, vertical line, inclined line • practice of Square, rectangle and polygons • Practice of circle etc. 1.8 Lettering 1.8.1. Concept of Lettering and its types 1.8.2. Advantages of Engineering lettering 1.8.3. Standard size and style of Engineering lettering such as: • Vertical Letter and Inclined Letter • Height & width ratio of letter 1.8.4. Letter writing practice as: • Upper case letter • Lower case letter • Numbers 1.9 Dimensioning 1.9.1 Concept of Dimensioning 1.9.2. Dimensioning system 1.9.3. General rules of Dimensioning 1.9.4. Advantages of Dimensioning	

		1.9.5. Standard size & Dimensioning • Chain and size dimension 1.9.6. Types of dimension lines as: • Extension (projection) line • Leader (pointer) line • Dot or hidden line • Breaking line • Arrow head 1.9.7. Procedure of dimension lines 1.9.8 Construct different types of dimensioning lines.	
2.	Introduction of geometrical shapes	2.1.Introduce a line and classification of lines 2.2. Procedure to draw different types of line. like • practice of horizontal line • Practice of vertical line and • Practice of inclined line as 30^0, 45^0, 60^0, etc. 2.3 Explain the uses and advantages of line. 2.4 Introduction of geometrical shape like : • Rectangle & Square • Triangle • Parallelogram, • Rhombus and • Polygon. ➢ Pentagon ➢ Hexagon ➢ Octagon ➢ Nonagon 2.5Concept of Circle and its parts 2.6. Concept of division	**10**

		2.6.1. Types of division of line and Angle • Bisect • Trisect 2.6.2. General rules of division 2.6.3Process of line dividing in any number of equal parts 2.6.4Dividing of circle in any number of equal parts	
3	**Scale**	3.1. Provide the concept of Scale 3.2. Types of scale • Geometrical scale • Non geometrical 3.3. Advantages of different types of scale 3.4. Procedure to prepare a different types of scale such as: • practice of Full Scale (1:1) • Practice of Reduced Scale (1:2) • Practice of Enlarge Scale (2:1)	3
4	Tangent	4.1. Concept of Tangent 4.2. Types of Tangent. • Line Tangent • Line Tangent to a circle from any point • Uncrossed (Open belt) Line Tangent • Crossed (Crossed belt) Line Tangent • Arc tangent ➢ Internal arc tangent ➢ External Arc Tangent ➢ Combined Arc Tangent 4.3Process of constructing Tangent	**3**

5	Engineering Curves and conic section	5.1. Concept of Curve. 5.2. Types of Engineering Curve. • Line, square, triangle and circular involutes • Cycloid • Helix ➢ Cylindrical Helix ➢ Conical Helix 5.3 Construct different types of Engineering curves 5.4. Concept of Cone & Conic section 5.5. Construct different types of Cone & Conic section • Circle, Ellipse, Parabola, Hyperbola(only introduction) • Types of Ellipse ➢ Concentric method ➢ Oblong method ➢ Foci method (Centre point method) • Types of Parabola ➢ Rectangle method ➢ Tangent method	**10**
6	Orthographic Projection	6.1. Concept Projection 6.2. Introduction of Orthographic Projection. 6.3. Principle of projection. 6.4. General rules of projection. 6.5. Concept of first angle and third angle projection 6.6. Rules of the first angle and third angle projection 6.7 Differentiate of the first angle and third angle projection 6.8 Procedure of Orthographic projection	**14**

		6.9. Construct different types of Orthographic projection. At least 15 practice. • Prism • Cylinder • Pyramid • Cone 6.10. Construct different types of Orthographic projection of Different Combine models • Model with flat • Model with inclined • Model with circular surface 6.11. Concept of section 6.12. General rules of section 6.13. Need and importance of section 6.14. Different type of sectional plane : • Longitudinal as half and full section • Crossed section as half and full section 6.15. Construction of Different type of sectional plane: • Longitudinal as half and full section • Crossed section as half and full section 6.16. Practice of sectional view on circular and flat surfaces.	
7	Pictorial Projection	7.1. Introduction of Pictorial Projection 7.2 Types of Pictorial Projection. • Oblique • Isometric • Perspective 7.3. General rules of Pictorial projection.	**10**

		7.4. Construct different types of Pictorial projection. At least 15 practice. • Oblique • Isometric • Perspective • Different Combine models etc. 7.5Orthographic projection of a model into Isometric and Oblique View by box method. 7.6 Projection of points 14.6.1. Concept of projection of points 14.6.2 Projection of points at different quadrants	
8	Surface Development	8.1. Concept of Development. 8.2. Introduction of surface Development. 8.3. Practice of following method of surface development • Parallel line method • Radial line method • Triangulation Method 8.4.Practice of following Surface development of : • Prism • Cylinder • Pyramid and • Cone	**6**
		Total	**64**

5. Suggested Practical and Project Works

The practical work that students do during their course is aimed at providing them learning opportunities to accomplish competency of the curriculum as well as reinforcing their learning of the theoretical subject content. Similarly, involving in a

project work fosters the self-learning of students in the both theoretical and practical contents. As this subject emphasizes to develop both theoretical and practical knowledge and skills, some of the practical and project works are suggested for the students. However, the tasks presented here are the samples only. A teacher can assign the extra practical and project works as per the students' need or specific context.

S.N.	Grade 9		
	Content Area	**Suggested Practical Activities**	**Hrs.**
1	Introduction to drawing	Familiarize with drawing tools and equipment. Draw different shapes and line free handly. Use of different methods of lettering and numbering. Use different method of dimensioning to label the given objects. Chain and size dimension	4
2	Introduction to geometrical shapes	2.1 Familiarize with different lines and shapes. 2.2 Practicing the lines and circle 2.3 Construction of different shapes Angles Triangles Circles Squares Polygons Pentagon Hexagon Octagon Nonagon Practicing of bisecting and trisecting an angle. Division of line into number of equal parts	8
3	Scale	3.1 Make use of scales both reduced and enlarged.	2
4	Tangent	4.1 Draw different types of tangent using following methods	4

		• Line Tangent • Line Tangent to a circle from any point • Uncrossed (Open belt) Line Tangent • Crossed (Crossed belt) Line Tangent • Arc tangent ➢ Internal arc tangent ➢ External Arc Tangent ➢ Combined Arc Tangent	
5	Engineering Curves and conic section	5.1 Draw the following curves • Involute of Line, square, triangle and circle • Cycloid • Helix ➢ Cylindrical Helix ➢ Conical Helix 5.2 Draw different conics by following methods • Ellipse ➢ Concentric method ➢ Oblong method ➢ Foci method (Centre point method) • Parabola ➢ Rectangle method ➢ Tangent method ➢ Hyperbola	12
6	Orthographic Projection	6.1Draw the orthographic projection of different objects given. • Prism • Cylinder • Pyramid	16

		• Cone 6.2. Construct different types of Orthographic projection of Different Combine models • Model with flat • Model with inclined • Model with circular surface 6.3. Construct different type of sectional plane of given objects: • Longitudinal as half and full section • Crossed section as half and full section 6.4. Practice of sectional view on circular and flat surfaces.	
7	Pictorial Projection	7.1. Construct different types of Pictorial projection. At least 15 practice. • Oblique • Isometric • Perspective • Different Combine models etc 7.2 Converting the orthographic projection of a model into Isometric and Oblique View by box method 7.3 Practice of projection of points at different quadrants	12
8	Surface Development	8.1. Practice the surface development of given objects: • Prism • Cylinder • Pyramid • Cone	6
	Total		**64**

6. Learning Facilitation Process

Learning facilitation process is determined according to the content to be dealt in the subject. It's also an art of teacher. The teacher should utilize such teaching methods and techniques that are appropriate to the contents and needs of the students. In facilitating the course, various approaches, methods and techniques are used. To be particular, the following major methods and strategies are used in this subject:

- Discussion
- Demonstration
- Presentation
- Project works
- Audio/Visual Classes
- Assignments
- Observations
- Group work/ Case study

7. Student Evaluation

Evaluation is an integral part of learning process. Both formative and summative modes of evaluation are emphasized. Formative evaluation will be conducted so as to provide regular feedback for students, teachers and parents/guardians about how student learning is. Class tests, unit tests, oral question-answer, home assignment etc, are some ways of formative evaluation.

There will be separate evaluation of theoretical and practical learning. Summative evaluation embraces theoretical examination, practical examination and evaluation of research work or innovative work.

(a) Internal Evaluation

Internal evaluation covers 50 Percent weight age. Internal evaluation consists of Practical Activities (Practical works and projects works) (35 Percent), (b) Marks from trimester examinations (10 Percent), and (c) Classroom participation (5 Percent). Practical work should be based on list of activities mentioned in this curriculum. Project

works should be based on the mentioned lists or created by teachers. Mark distribution for internal evaluation (practical work and project work) will be as follows:

S.N.	Mani activities	Activities in detail	Percent
1	Participation	Participation in attendance, homework, classwork, project work, practical works etc.	5
2	Practical work	Conduction of practical work activities	15
		Record keeping of practical work activities	3
3	Project work	Conduction of project work activities	10
		Record keeping of project work activities	2
4	Viva	Viva of practical work and project work activities	5
6	Internal exam	First trimester 5 marks and Second trimester 5 marks	10
Total			50

Note:

(i) Practical examination will be conducted in the presence of internal and external supervisors. Evaluation of experiment will focus both the product of work and skills competencies of student in using apparatus.

(ii) Project work assessment is the internal assessment of reports and presentation of their project works either individually or group basis. In case of group presentation, every member of the group should submit a short reflection on the presented report in their own language. Records of project works must be attested by external supervisor.

(b) External Evaluation

There will be an external written examination which which covers 50% of the weight. It will be based on the specification grid developed by Curriculum Development Centre. Examination question paper will be developed using various levels of revised Bloom's taxonomy including remembering level, understanding level, application level and higher ability (analyzing, evaluating, creating).

Specification Grid

Grade: 9 Subjects : Engineering Drawing Time : 2 hrs.

Unit	Content	Credit hrs.	Knowledge and Understand			Application			Higher Ability			Total Question Number			Total Question	Marks Weight			Total Marks
			MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long		MCQ	Short	Long	
1	Introduction of drawing	8	6	2	1	3	3	0	0	0	1	9	5	2	16	9	25	16	6
2	Introduction of geometrical shapes	10																	8
3	Scale	3																	2
4	Tangent	3																	2
5	Engineering Curves and conic section	10																	8
6	Orthographic Projection	14																	12
7	Pictorial Projection	10																	8
8	Surface Development	6																	4
	Total	64	6	2	1	3	3	0	0	0	1	9	5	2	16	9	25	16	50

Basic Electrical Engineering

Grades: 9 **Credit hrs: 4** **Working hrs: 128**

1. Introduction

Basic electrical engineering is one of the subjects designed to provide students with basic and fundamental skills related to electrical engineering. Thus course provides knowledge on basic concept related to electrical energy and the calculations related with it. Beside these it gives concept about the magnetism and the laws related to electromagnetism. It also provides concept about the AC signals and its parameters. It is designed in such a way that the students on completion of this course will develop the fundamental knowledge and skills related to the subject.

The curriculum comprises of the contents like: DC Electric Circuit, Capacitors, Magnetism and Electromagnetism, Fundamentals of alternating current and single phase circuits and three phases circuit. The course itself is of practical nature, thereby, the pedagogical approaches in delivering the course should consider the balance between theory and practice. The course will impart the student not only the basic knowledge and skills in the various aspects of electrical Engineering but also inculcate them service culture, self-discipline, teamwork, problem-solving, communication and presentation skills.

The curriculum prepared in accordance with National Curriculum Framework is structured in such a way that it incorporates the level-wise competencies, grade-wise leaning outcomes, scope and sequence of contents, suggested practical/project activities, learning facilitation process and assessment strategies so as to enhance the learning on the subject systematically.

2. Competencies

On completion of the course, the students will have the following competencies:

1. Develop a concept about electrical energy
2. Explain the concept of circuit, its type and parameters
3. Develop an ideas about the laws related with electricity
4. Gain concept about capacitor and capacitance

5. Understand about magnetism and electromagnetism
6. Acquire basic ideas of different parameters of AC
7. Acquire skills in three phase systems.

3. Grade-wise Learning Outcomes

S.N.	Content Area	Learning Outcomes
1	Electrostatics	1.1 Introduce Electricity and its history. 1.2. Introduce Atom and it's structure. 1.3. Identify Atomic Number, Atomic Weight, Free Electrons and Electric charge. 1.4. List the types of electricity. 1.5. Provide the concept of force. 1.6 State force between two charges (Coulumb's law). 1.7. Introduce electric field, potential and potential difference. 1.8 Electromotive force and battery.
2	DC Electric Circuit	2.1 Describe electric circuit and its parameter. 2.2. State the movement of electrons in a conductor. 2.3. Provide concept and definition of electric current and its unit. 2.4. Discuss conventional direction of electric current and its uses. 2.5. Describe electric resistance and its role of electric resistance in electrical circuits. 2.6. List the factors affecting the value of Resistances, specific resistance. 2.7. List the types of Electric circuits. 2.8. Describe the connection of Resistances and calculate its equivalent resistance.

		2.9. List the Uses and advantages of Series and Parallel Circuit 2.10 State Ohm's Law and its application. 2.11 State Kirchhoff's Current Law. 2.12 Introduce electrical power. 2.13 Describe electrical energy, its unit and practical application.
3	Capacitors	3.1 Introduce capacitor. 3.2 List the affecting factors of capacitance of a capacitor 3.3 Write the characteristics of parallel plate capacitor 3.4 Arrange the capacitors in series and parallel and find its equivalence. 3.5 Describe the concept of charging and discharging of capacitor.
4	Magnetism and Electromagnetism	4.1 Introduce the magnet and magnetism and the terminologies. 4.2 Classify magnet. 4.3 Identify the magnetic and non-magnetic materials. 4.4 Find the magnetic field and its direction due to a current carrying conductor. 4.5 State the principle of electromagnetism. 4.6 State & explain the Faraday's law of electromagnetic induction. 4.7 Introduce Statically and dynamically induced emf. 4.8 Introduce Inductor, inductance and its Unit. 4.9 Compare between electric and magnetic circuit.
5	Fundamentals of alternating current and single phase	6.1. Identify D C current and AC current and compare them. 6.2 Describe the terms of AC.

	circuits	6.3. Analyze different types of AC circuit.
6	Three phase Circuit	7.1 Provide the concept of three phase system. 7.2 Analyze idea of generation of 3-phase emf and phase sequence. 7.3. Introduce Balance and unbalanced system. 7.4 Describe of Star connection and delta connection. 7.5. Describe the terms in star and delta connection and write relation between them. 7.6. List the advantages of three phase over single phase.

4. Scope and Sequence of Contents

S.N.	Content Area	Elaboration of Contents	Hrs.
1.	**Electrostatics**	1.1 Concept of Electricity and its history. 1.2 Concept of Atom and its structure. • Electron • Proton • Neutron 1.3 Introduction of Atomic Number, Atomic Weight, Free Electrons and Electric charge 1.4 Types of Electricity. • Dynamic • Static 1.5. Provide the concept of force. 1.6 Force between two charges. (Coulumb's law) 1.7 Define electric field , potential and potential difference 1.8 Electromotive force and battery 1.9. Sources of energy, voltage and its units.	4
2.	DC Electric	2.1 Electric Circuit and its parameter.	**16**

	Circuit	• Voltage • Current and • Resistance 2.2 Movement of Electrons in a conductor. 2.3 Provide Concept and Definition of Electric Current and its unit. 2.4 Conventional direction of Electric Current. & its uses 2.5 Electric Resistance and its role of Electric Resistance in Electrical Circuits. 2.6 Factors affecting the value of Resistances, specific resistance 2.7 Types of Electric circuits • Open Circuit • Close Circuit • Short circuit 2.8 Connection of Resistances in Series and Parallel and their equivalent resistance. 2.9 Uses and advantages of Series and Parallel Circuit 2.10 Ohm's Law and its application. 2.11 Kirchhoff's Current Law.(Nodal analysis) 2.12 Kirchhoff's Voltage Law (Loop analysis)(with 2 loops) 2.13 Electrical power, its Unit and practical application 2.14 Electrical energy, its Unit and practical application 2.15 Simple numerical examples related to Unit 2	

3	Capacitors	3.1 Capacitor and Capacitance and its units. 3.2 Factors affecting of capacitance of a capacitor 3.3 Characteristics of parallel plate capacitor 3.4 Series and parallel connection of capacitor and their equivalent. 3.5. Concept of charging and discharging of capacitor.	6
4	Magnetism and Electromagnetism	4.1 Magnet and magnetism. 4.2 Types of magnet • Temporary magnet • Permanent magnet 4.3 Magnetic and non-magnetic materials 4.4 Magnetic terminology • Magnetic field • Magnetic field intensity • Lines of magnetic flux • Flux density 4.5 Magnetic field and its direction due to a current carrying conductor 4.6 Principle of electromagnetism. 4.7 Faraday's law of electromagnetic induction. 4.8 Statically and dynamically induced emf. 4.9 Inductor, inductance and its Unit. • Self-Inductance • Mutual Inductance	8

5	Fundamentals of alternating current and single phase circuits	5.1. D C current and AC current and compare them. 5.2 Generation of AC voltage 5.2 Terms of AC fundamentals (Wave, cycle, frequency, wavelength, time Hrs., amplitude, phase, phase difference, instantaneous, RMS, Average value, form factor, peak factor) 5.3 Reactance and impedance 5.4 Analysis of simple AC circuits (waveform, phasor diagram and equation, power factor, active and reactive power). 5.4.1 Resistor only • Inductor only • Capacitor only • Resistor and capacitor in series • Resistor and Inductor in series • Resistor. Inductor and capacitor in series • Parallel AC circuit 5.5 Solve the Simple numerical examples.	18
6	Three phase Circuit	6.1 Concept of three phase system and generation of 3-phase voltage 6.2 General idea of generation of 3-phase emf and phase sequence. 6.3 Balance and unbalanced system 6.4 Concept of Star connection and Delta connection 6.5 Explain the following terms • Line voltage • Phase voltage • Line current • Phase current	12

		6.6 Relationship between line and phase quantities in star and delta connection. 6.7 Power in three phase system 6.7 Advantages of three phase over single phase	
	Total		**64**

5. Suggested Practical and Project Works

The practical and project works are integral parts of reinforcing the students' learning. So the new curriculum provisions the practical and projects works as a part of curriculum. Some of the sample practical and project works are suggested herewith. However, a teacher can adapt them or use similar other project works as per their students need and specific context.

Unit	**Grade 9**		
	Content Area	**Practical Activities**	**Hrs.**
1	Electrostatics	1.1 Demonstrate the phenomenon of electrification by friction (static electricity) with the help of glass bar and silk.	2
2	DC Electric Circuit	2.1 Familiarize with electrical instruments like voltmeter, ammeter, galvanometer, multimeter, power supply unitetc. 2.2. Perform the correct connection of the voltmeter, ammeter, fixed and variable resistors in an electrical circuit and hence observe the correct handling and application of the equipment. 2.3. Measure the resistance of a resistor using voltmeter and ammeter. 2.4. Connect the resistors in series and parallel and calculate the equivalent resistance using voltmeters and ammeters.	16

		2.5. Verification of Ohm's law. 2.6 Verify Kirchhoff's law. • KCL • KVL 2.7 Calculation of power In resistive circuit by using multi meter and verify it with watt meter reading. 2.8 Calculation of energy consumed by resistive circuit using multi meter for 10 minutes.	
3	Capacitors	3.1. Demonstrate the different component of different types of capacitor. 3.2 Connect capacitors in series and parallel and hence find the equivalent capacitance and voltage. 3.3 Observation of charging and discharging of capacitor in oscilloscope.	6
4	Magnetism and Electromagnetism	4.1. Perform the experiments with permanent magnet and trace the magnetic lines of force and observe the interaction of magnets. 4.2. Perform an experiment to verify the existence of a magnetic field around a conductor carrying current and observe its direction. 4.3. Perform an experiment to verify that a force experienced by a current carrying conductor in a magnetic field and observe its direction.	14

		4.4. Verify Faraday's law of electromagnetic induction using galvanometer and voltmeter and hence observe the magnitude and direction of the induced emf.	
5	Fundamentals of alternating current and single phase circuits	5.1 Use oscilloscope and be familiar with its operation to observe different types of waveform of dc/ac quantities. 5.2 Use oscilloscope to measure frequency, time Hrs., phase and phase difference of an alternating voltage. 5.3 Perform measurement and measurement of current and voltage in an R-L,R-C and R-L-C series circuits and hence verify the results.	18
6	Three phase Circuit	6.1. To be familiar with 3-phase supply and 3-phase load. 6.2. To be familiar with star and delta connections 6.3. Connect the load in star, measure line and phase currents and voltages. 6.4. Connect the load in delta, measure line and phase currents and voltages.	8
	Total		**64**

6. Learning Facilitation Process

This course aims to blend both theoretical and practical aspects of knowledge and skills required in the subject. So, its facilitation process differs from the traditional method of delivery. The practical aspect is much more focused. So, methods and strategies that enable the practical skills in the students are much used in course of content facilitation. A facilitator encourages and assists students to learn for themselves engaging in different activities with practical tasks. To achieve the entire objectives from this syllabus, the teacher must use different techniques and process while teaching. In

particular, the teacher can make use of the following methods and strategies for the learning facilitation:

- Discussion
- Demonstration/Slide shows
- Problem solving
- Presentation
- Case study
- Practical works
- Project works
- Field visit and report writing
- Group works and pair works
- Audio/Visual Classes

7. Student Evaluation

Evaluation is an integral part of learning process. Both formative and summative modes of evaluation are emphasized. Formative evaluation will be conducted so as to provide regular feedback for students, teachers and parents/guardians about how student learning is. Class tests, unit tests, oral question-answer, home assignment etc, are some ways of formative evaluation.

There will be separate evaluation of theoretical and practical learning. Summative evaluation embraces theoretical examination, practical examination and evaluation of research work or innovative work.

(a) Internal Evaluation

Internal evaluation covers 50 Percent weight age. Internal evaluation consists of Practical Activities (Practical works and projects works) (35 Percent), (b) Marks from trimester examinations (10 Percent), and (c) Classroom participation (5 Percent). Practical work should be based on list of activities mentioned in this curriculum. Project works should be based on the mentioned lists or created by teachers. Mark distribution for internal evaluation (practical work and project work) will be as follows:

S.N.	Mani activities	Activities in detail	Percent
1	Participation	Participation in attendance, homework, classwork, project work, practical works etc.	5
2	Practical work	Conduction of practical work activities	15
		Record keeping of practical work activities	3
3	Project work	Conduction of project work activities	10
		Record keeping of project work activities	2
4	Viva	Viva of practical work and project work activities	5
6	Internal exam	First trimester 5 marks and Second trimester 5 marks	10
Total			50

Note:

(i) Practical examination will be conducted in the presence of internal and external supervisors. Evaluation of experiment will focus both the product of work and skills competencies of student in using apparatus.

(ii) Project work assessment is the internal assessment of reports and presentation of their project works either individually or group basis. In case of group presentation, every member of the group should submit a short reflection on the presented report in their own language. Records of project works must be attested by external supervisor.

(b) External Evaluation

Theoretical evaluation covers 50% of marks. The tool for external evaluation of theoretical learning will be a written examination. Questions for the external examination will be based on the specification grid developed by Curriculum Development Centre. Examination question paper will be developed using various levels of revised Bloom's taxonomy including remembering level, understanding level, application level and higher ability (analyzing, evaluating, creating).

Specification Grid

Grade: 9 Subjects : Basic Electrical Engineering Time : 2 hrs.

Unit	Content	Credit hrs.	Knowledge and Understand			Application			Higher Ability			Total Question Number			Total Question	Marks Weight			Total Marks
			MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long		MCQ	Short	Long	
1	Electrostatics	4																	2
2	DC Electric Circuit	16																	14
3	Capacitors	6																	4
4	Magnetism and Electromagnetism	8																	6
5	Fundamentals of alternating current and single phase circuits	18																	14
6	Three phase Circuit	12	6	2	0	3	2	1	0	1	1	9	5	2	16	9	25	16	10
	Total	64	6	2	0	3	2	1	0	1	1	9	5	2	16	9	25	16	50

Basic Electrical Installation and Workshop Technology

Grades: 9 Credit hrs: 4 Working hrs: 128

1. Introduction

Basic electrical installation and workshop technology is a one of the fundamental skills in electrical engineering. This curriculum is designed to provide students with general understanding of the fundamental electrical installation and workshop technology. This course provides knowledge and skills in electrical installation work of residential buildings. It gives clear concept of safety rules and regulations to be followed during installation works. It gives information about the tools and equipment required for doing installation works. Understanding of such concepts and their application, in day to day context as well as the process of obtaining new knowledge through holistic approach of learning in the spirit of national qualification framework is emphasized in the curriculum.

This curriculum comprises of contents like: Electrical safety practices, wiring regulation, proper use of tools and accessories, protective devices and Earthing and lightning protection system, electrical wiring system, wires and cables, installation of wiring system, Inspection, testing and maintenance of wiring System.

The curriculum prepared in accordance with National Curriculum Framework is structured in such a way that it incorporates the level-wise competencies, grade-wise leaning outcomes, scope and sequence of contents, suggested practical/project activities, learning facilitation process and assessment strategies so as to enhance the learning on the subject systematically.

2. Competencies

On completion of the course, the students will have the following competencies:

1. Acquire and use the knowledge about handling hand tools safely
2. Acquire and use the skills in operating workshop tools and equipment
3. Apply the knowledge of general rules of safety and wiring

4. Determine proper sizes of wires and protective devices
5. Identify and use wiring accessories, measuring and protection devices
6. Understand and apply the skills of wiring system.
7. Acquire and use the skills in inspection, testing and maintenance of wiring system.

3. Grade-wise Learning Outcomes

S.N.	Content Area	Learning Outcomes
1	Electrical Safety Practices	1.1 Introduce safety measures. 1.2 Describe Rescue operations.
2	Wiring Regulation	2.1. Introduce Electrical Codes.
3	Proper use of tools and accessories	3.1. Identify and select proper tools and their handling correctly. 3.2. Identify various types, sizes, rating of electrical and workshop tools and materials. 3.3 Identify types of switches. 3.4 Describe different types of lamps. 3.5 Introduce types of Power Socket. 3.6 Describe types of boxes.
4	Protective devices and Earthing and Lightning Protection System	4.1. Introduce protective devices. 4.2. List the advantages of protective devices. 4.3. List out different types of fuses. 4.4. Provide the concept of fuse, MCB and their functions. 4.5. Identify fuse/MCB and their ratings. 4.6 Introduce Earthing. 4.7 Introduce Lightning Protection System(LPS).
5	Electrical wiring system	5.1. Introduce different wiring systems. 5.2 List out the type of wiring, accessories, advantages and disadvantages.

		5.3 Identify the types of wiring. 5.4 Describe the rules of wiring. 5.5. Identify the types and sizes of wire in metric unit and SWG. 5.6 Introduce technical drawings and specifications as per standards related to wiring.
6	Installation of wiring system	6.1 Provide concept of Electric diagram and electric symbol. 6.2 Introduce electrical diagram and symbol and mark route. 6.3 Installation of Conduits and setting cables. 6.4 Installation of energy metering system. 6.5. Interpretation of the drawings and specifications in Electrical Installation.
7	Inspection, Testing and Maintenance of Wiring System	7.1. Familiarize with test instruments. 7.2. Identify test methods. 7.3. Describe Continuity and discontinuity test of fuses, MCB, wires, etc.

4. Scope and Sequence of Contents

S.N.	Content Area	Elaboration of Contents	Hrs.
1.	Electrical Safety Practices	1.1. Concept and introduction of safety 1.1.1 Safety rules & regulations in electrical installation works 1.1.2 Importance of Safety related work practices 1.1.3 Causes of electrical shock and its effect 1.1.4 Safety rules - Safety signs – Hazards 1.1.5 Safety attires(Safety shoes, safety gloves, helmet, goggles and uniform) and tools 1.1.6 Fire - Types – Extinguishers	5

		1.1.7 Safety Precautions and Regulations 1.2 Rescue operations - First aid treatment - Artificial respiration 1.2.1. Safe value of electric current and voltage through human body 1.2.2. Rescue operations 1.2.3. First aid for Electric Shock 1.2.4. Cardiopulmonary Resuscitation (CPR)	
2.	Wiring Regulation	2.1. Electrical Codes 2.1.1. Basics of Nepal National Building Code • NBC (Electrical requirements for Public Buildings) • NBC (Provisional Recommendation on Fire Safety) 2.1.2 Basics of Nepal Electricity Rules, 2050	3
3	Proper use of tools and accessories	3.1. Identify and select proper tools and their handling 3.1.1 Different types of tools and accessories 3.1.2 Proper handling of tools 3.1.3 Differentiate among tools, equipment, materials and accessories 3.2. Identify various types, sizes, rating of electrical tools and materials 3.2.1. Working procedure of using tools and materials 3.2.1.1 Tools- (Adjustable wrench, Wire stripper, Mallet, C-clamp , Chisels, Drill bits Files, Spanner, Wrenches, Hacksaw , Hammers, Measuring tape, Pliers, Snipers, Punches , Try square , Neon tester , Wire cutters , Set squares , Electrician knife , Ladder etc.) 3.2.1.2 Definition & uses of Pliers & Snipers: • Combination Pliers • Long Nose Pliers	16

		• Flat Nose Pliers • Circle Lip Pliers • Slip Joint Pliers • Diagonal Cutting Pliers • Side Cutting Pliers • Tin Snipers Marking – Scribers: • Centre Punch • Pin Punch • Letter and Number Punch • Plumb Bob Measuring Tools • Collapsible Steel Measuring Tape • Metallic Scale Bar • Try Square •Vernier Caliper • Micro Meter • Divider and Feeler Gauge Workshop Materials Provide the specification & uses of others Workshop Materials • Types of Steel sheets • Bars/Strips • Angled Bar • Nuts and Bolts • Screws • Nails • Rivets 3.2.1.3 Materials- (Channel Elbow , Bend , PVC circular box , Saddle , Cable lugs , Cable tie , Thread	

		ball , Insulating clip, Flexible conduit , Plastic tape etc) 3.3 Types of switches(on the basis of number of poles, usage and number of gangs) 3.4 Types of lamps (LED, Fluorescent, Incandescent etc) 3.5 Types of Power Socket 3.6 Definition and Size of boxes(Junction box, Distribution Box, Gang box, Power socket Box etc) as per standard	
4	Protective devices and Earthing and Lightning Protection System	4.1. Necessity of protective devices 4.2. Advantages of protective devices 4.3. Different types of fuses (Rewirable and non-rewirable fuses) 4.5. Concept of fuse, MCB and their functions 4.6. Selection and identification of fuse/MCB and their ratings 4.7. Concept of Molded Case Circuit Breaker(MCCB) , Residual Current Circuit Breaker (RCCB) and Residual Current Breaker with Overload Protection (RCBO) 4.8 Concept of Surge Protective Devices(SPD) 4.9 Introduction to Earthing • Earthing and its types(Equipment and System Earthing) • Methods of Earthing(Rod, Pipe, Strip and Plate) • Types and sizes of Earthing materials • Main earthing terminals • Importance of Earthing 4.10 Lightning Protection System(LPS) in buildings	12
5	Electrical wiring system	5.1. Introduction to wiring system • Tree System • Distribution system • Advantages and disadvantages	12

		5.2 Type of wiring, accessories, advantages and disadvantages •PVC casing and capping system •Conduit Wiring System Surface Conduit wiring Concealed Conduit wiring • Trunking Wiring System 5.3 Selection of wiring 5.4 Rules of wiring 5.5 Types and sizes of wire in metric unit and SWG 5.5 Technical drawings and specifications as per standards related to wiring	
6	Installation of wiring system	6.1 Electric diagram and electric symbol of accessories used in domestic wiring system • Layout • Wiring 6.2 Concept of electrical diagram and symbol and mark route. 6.3 Installation of Conduits and setting cables (use of fish wires) 6.4 Installation of energy metering system(Analog, digital, smart and dual source energy meter)	8
7	Inspection, Testing and Maintenance of Wiring System	7.1. Familiarization with Test Instruments • Continuity Test instruments(AVO or multi Meter) • Earth electrode test instruments • Insulation test instruments 7.2. Familiarization with Test methods • Insulation tests • Polarity tests • Continuity tests • Earth electrode tests	8

		7.3. Continuity and discontinuity test of fuses, MCB, wires, etc.	
	Total		**64**

5. Suggested Practical and Project Works

The practical work that students do during their course is aimed at providing them learning opportunities to accomplish competency of the curriculum as well as reinforcing their learning of the theoretical subject content. Similarly, involving in a project work fosters the self-learning of students in the both theoretical and practical contents. As this subject emphasizes to develop both theoretical and practical knowledge and skills, some of the practical and project works are suggested for the students. However, the tasks presented here are the samples only. A teacher can assign the extra practical and project works as per the students' need or specific context.

S.N.	**Grade 9**		
	Content Area	**Practical Activities**	**Hrs.**
1	Electrical Safety Practices	1.1 Demonstrate easy handling procedure of heavy loads safe lifting method of small load manually, heavy loads by hoist pulley block, chain block. 1.2 Demonstrate safe rescue procedures. 1.3 Demonstration of CPR 1.4 Prepare a list of safety procedures for electrical installations.	2
3	Proper use of tools and accessories	3.1. Demonstrate common electrical materials with standard ratings and specifications such as wires, cables, switches, fuses, Mcbs, conduits, lamps etc. 3.2. Demonstration and identification of common electrical accessories with standard ratings and specifications such as clamps and allied items,	8

		tools and accessories. 3.3 Identification of phase, Neutral and Earth wires for connection to domestic electrical appliances and their connections to three pin plugs. 3.4. Demonstration of house wiring circuits- fuse, switches, sockets, ceiling rose etc. 3.5. Distinguish several kinds of installation tools and materials. 3.6. Practice of basic cutting, drilling and welding using electrical machineries 3.7. Make a Sheet Junction box and a distribution box using the workshop technology skills and knowledge.	
4	Protective devices and Earthing and Lightning Protection System	4.1. Observation of protective devices in domestic installations 4.2. Observation of protective devices in commercial building installations 4.3. Demonstration of tripping of fuses and MCBs 4.5. Identify fuse/MCB and their ratings 4.6 Observation of different kinds of earthing electrodes 4.7. Practice of dummy earthing arrangement using any kind of earth electrode using available local materials 4.8. Field visit of Earthing arrangements and Lightning Protection System(LPS) in a commercial building	6
5	Electrical wiring system	5.1. Observation of different types of electrical	2

		wiring systems 5.2. Demonstration of various sizes of wire (1.5, 2.5, 4, 6 mm^2copper/aluminum, flexible, Stranded wires) Ask to cut in 10 cm length of each and strip out insulation 1 cm each side each piece. 5.3. Identify Types and sizes of wire in metric unit and SWG 5.4 Introduce technical drawings related to wiring	
6	Installation of wiring system	6.1. Demonstrate different kinds of wiring system 6.2. Connect 3 pin 15 amp switches/socket as per given layout diagram. 6.3. Make extension power cord using 3 nos (colour) wire 4mm^2, 3 pin plug and switch combined 3 pin 5/15 socket. 6.4 Connect single lamp control by single 5 amp switch in surface PVC trunking. 6.5. Connect single bell control by single push button switch in PVC Trunking wiring. 6.6 Connect two lamp in parallel control by simple one way switch. 6.7 Connect one lamp by using one way switch. Also connect two pin socket and indicator in 3 gang plate. 6.8. Connect a lamp control separately by two simple switches.(two way switching) 6.9. Connect two lamp in parallel control by a simple one way switch and third lamp by another switch in a 2 way gang plate.	38

		6.10. Connect one lamp, one bell and a fan in a gang plate and also connect power socket 3 pin/ 15 A separately. 6.11 Connect two or more lamp in parallel and control from three or more places.(intermediate switches) 6.12. Install and connect energy meter, main switch and 6 way DB box(DPMCB32A, SPMCB16A and SPMCB6A) to a different power and lighting circuits.	
7	Inspection, Testing and Maintenance of Wiring System	7.1. Demonstrate test instruments 7.2. Perform polarity test of single pole switches, SPMCB, fuse etc. 7.3. Perform continuity test of switches, fuses, MCB etc. 7.4. Perform insulation test between conductors of wiring system 7.5. Perform earth continuity test	8
	Total		64

6. Learning Facilitation Process

This course intends to provide both theoretical as well as practical knowledge and skills on the subject, thereby, blends with both theoretical and practical facilitation strategies to ensure better learning. In fulfilling the learning outcomes stated in the curriculum, the teacher should use a variety of methods and techniques that fit to the contents. In particular, the following methods, techniques and strategies are used for learning facilitation:

- Demonstration
- Practical Works
- Audio/Visual use from different sources
- Project Works

- Exploration/ Field visit
- Discussion
- Group works and pair works

7. Student Evaluation

Evaluation is an integral part of learning process. Both formative and summative modes of evaluation are emphasized. Formative evaluation will be conducted so as to provide regular feedback for students, teachers and parents/guardians about how student learning is. Class tests, unit tests, oral question-answer, home assignment etc, are some ways of formative evaluation.

There will be separate evaluation of theoretical and practical learning. Summative evaluation embraces theoretical examination, practical examination and evaluation of research work or innovative work.

(a) Internal Evaluation

Internal evaluation covers 50 Percent weight age. Internal evaluation consists of Practical Activities (Practical works and projects works) (35 Percent), (b) Marks from trimester examinations (10 Percent), and (c) Classroom participation (5 Percent). Practical work should be based on list of activities mentioned in this curriculum. Project works should be based on the mentioned lists or created by teachers. Mark distribution for internal evaluation (practical work and project work) will be as follows:

S.N.	Mani activities	Activities in detail	Percent
1	Participation	Participation in attendance, homework, classwork, project work, practical works etc.	5
2	Practical work	Conduction of practical work activities	15
		Record keeping of practical work activities	3
3	Project work	Conduction of project work activities	10
		Record keeping of project work activities	2
4	Viva	Viva of practical work and project work activities	5

6	Internal exam	First trimester 5 marks and Second trimester 5 marks	10
Total			50

Note:

(i) Practical examination will be conducted in the presence of internal and external supervisors. Evaluation of experiment will focus both the product of work and skills competencies of student in using apparatus.

(ii) Project work assessment is the internal assessment of reports and presentation of their project works either individually or group basis. In case of group presentation, every member of the group should submit a short reflection on the presented report in their own language. Records of project works must be attested by external supervisor.

(b) External Evaluation

Theoretical evaluation covers 50 marks. The tool for external evaluation of theoretical learning will be a written examination. Questions for the external examination will be based on the specification grid developed by Curriculum Development Centre. Examination question paper will be developed using various levels of revised Bloom's taxonomy including remembering level, understanding level, application level and higher ability (analyzing, evaluating, creating).

Specification Grid

Grade: 9 Subjects : Basic Electrical Installation and Workshop Technology g Time : 2 hrs.

Unit	Content	Credit hrs.	Knowledge and Understand			Application			Higher Ability			Total Question Number			Total Question	Marks Weight			Total Marks
			MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long		MCQ	Short	Long	
1	Electrical Safety Practices	5	6	1	0	3	3	1	0	1	1	9	5	2	16	9	25	16	3
2	Wiring Regulation	3																	1
3	Proper use of tools and accessories	16																	14
4	Protective devices and Earthing and Lightning Protection System	12																	10
5	Electrical wiring system	12																	10
6	Installation of wiring system	8																	6
7	Inspection, Testing	8																	6

	and Maintenance of Wiring System																		
	Total	64	6	1	0	3	3	1	0	1	1	9	5	2	16	9	25	16	50

Class 10

Electrical Machine

Grades: 10 Credit hrs: 4 Working hrs: 128

1. Introduction

In electrical engineering, electric machine is a general term for machines using electromagnetic forces, such as electric motors, electric generators, and others. They are electromechanical energy converters: an electric motor converts electricity to mechanical power while an electric generator converts mechanical power to electricity. This curriculum on electrical machine is designed to provide students with general understanding of the electrical machine and their uses.

This curriculum comprises of fundamental conceptual principles and practices related to transformer, DC Machines, Three phase induction machines, synchronous machines and single phase fractional horse power motors. The course itself is of practical nature and the pedagogical approaches in delivering the course should consider the balance between theory and practice.

The curriculum is prepared in accordance with National Curriculum Framework and is structured in such a way that it incorporates the level-wise competencies, grade-wise leaning outcomes, scope and sequence of contents, suggested practical/project activities, learning facilitation process and assessment strategies so as to enhance the learning on the subject systematically.

2. Competencies

On completion of the course, the students will have the following competencies:

1. Understand the constructional details of various electrical machines.
2. Understand the operating principle and applications of various electrical machines
3. Able to assemble and dissemble the machinery parts
4. Understand the applications of various machines
5. Know the starting and speed control of various motors.

3. Grade-wise Learning Outcomes

S.N.	Content Area	Learning Outcomes
1	Electromagnetism	1.1. Introduce to electromagnetism. 1.2 Introduce magnetic field around a straight current carrying conductor and a solenoid and methods to find its direction force between two parallel current carrying conductors. 1.3 Introduce force on a conductor placed in the magnetic field. 1.4 Introduce series & parallel magnetic circuits, simple problems. 1.5 Introduce the concept of hysteresis loop and hysteresis loss. 1.6 Introduce Electromagnetic Induction.
2	Transformer	2.1 Introduce transformer. 2.2. Show the construction of a single phase transformer. 2.3. Describe operation of transformer. 2.4. Introduce Losses and efficiency. 2.5. Introduce Three-phase transformer. 2.6. Provide concept of Auto Transformer. 2.7. Describe cooling of Transformer.
3	DC Machines	3.1. Introduce DC Machines. 3.2. Describe different parts of DC machine. 3.3. Introduce DC Generator. 3.4.Introduce DC Motor.
4	Three phase induction machines	4.1 Introduce Induction Motor. 4.2. Provide constructional details of Induction Motor. 4.3. Describe its Operation as motor. 4.4. Show Torque – slip characteristics of a three phase induction motor. 4.5. Describe starting of Three phase Induction motors.

		4.6. Control the speed of three-phase induction motor. 4.7. List the applications of three-phase induction motors.
5	Synchronous Machines	5.1 Introduce synchronous machines. 5.1 Describe Constructional details. 5.3. Describe its Operation as a generator. 5.4. Describe the parallel operation and synchronization of alternators. 5.5.Introduce Synchronous motor.
6	Single phase fractional horse power motors	6.1. Introduce Single phase induction motor. 6.2. List out the methods of making single phase induction motor self-starting. 6.3. Introduce Single phase series motor or universal motor.

4. Scope and Sequence of Contents

S.N.	Content Area	Elaboration of Contents	Hrs.
1	Electromagnetism	1.1. Electromagnetism 1.1.1 Introduction to Electromagnetism 1.1.2 Magnetic field around a straight current carrying conductor and a solenoid and methods to find its direction force between two parallel current carrying conductors 1.1.3 Force on a conductor placed in the magnetic field 1.1.4 Series & parallel magnetic circuits, simple problems 1.1.5. Concept of hysteresis loop and hysteresis loss 1.2 Electromagnetic Induction 1.2.1. Faraday's Laws of electromagnetic	6

		induction 1.2.2 Lenz's law. 1.2.3 Fleming's Right and Left Hand Rule 1.2.4 Principle of self and mutual induction 1.2.5 Inductances in series and parallel 1.2.6 Energy stored in a magnetic field	
2	Transformer	**2.1** Definition and functions of a transformer 2.2. Constructional details of a single phase transformer 2.2.1 Constructional features of a single phase transformer 2.2.2 Cores and windings of a single phase transformer. 2.2.3 Classification of Single phase transformer on the basis of core (Shell type and Core type Transformer) 2.3 Operation of transformer 2.3.1. Working principle of a transformer 2.3.2. EMF equation of a transformer 2.3.3. Transformation ratio 2.3.4 Basic concept of Transformer on Load and No-load condition(Mathematical interpretation not required) 2.3.5. Equivalent circuit diagram of a transformer 2.4 Losses and efficiency 2.4.1. Losses and efficiency of a transformer 2.4.2. Types of Losses of a transformer Copper Loss Iron Loss(Hysteresis and Eddy Current Loss) 2.4.3. Types of Efficiency of a transformer All day efficiency and Commercial efficiency	14

		2.4.4 Short Circuit and Open Circuit Test of a transformer 2.5. Three-phase transformer 2.5.1 Construction of three phase transformers 2.5.2 Types and connections of three phase Transformers 2.5.3 Differences between single phase and three phases Transformer 2.5.4. Single unit three phase transformer and three units of single phase transformer 2.5.5 Different parts of power transformers – tank, conservator, breather, explosion vent, Buchholz's relay, tap changer etc. 2.6. Parallel operation of Transformers 2.6.1. Necessary and Sufficient Conditions required for parallel operation of transformers 2.6.2. Parallel operation of transformers 1.7. Auto Transformer 2.7.1. Concept of an Auto Transformer 2.7.2. Working principle of an Auto Transformer 2.7.3. Applications of an Auto Transformer 2.8. Cooling of Transformer 2.8.1. Concept and necessity of cooling of Transformers 2.8.2. Methods of cooling of Transformers 2.9. Applications of Transformers	
3	DC Machines	3.1. Introduction of DC Machines 3.1.1. Definition of DC Machines 3.1.2. Types of DC Machines 3.1.3 DC Generator and Motor 3.1.3. Functions and applications of DC Machines	8

		3.2. Constructional details of DC Machine 3.2.1. Construction of DC Machines • Yoke (Body) • Field Pole • Field Winding • Armature Core • Armature winding •Commutator and carbon brush 3.3. DC Generator 3.3.1. Basic operating principle of DC Machine as a Generator 3.3.2. Emf equation of a DC Machine 3.3.3. Types of DC Generators according to excitation • Self-excited • Separately excited • Series • Shunt • Compound 3.3.4. Basic concept of Voltage Build up in DC Generators 3.3.5. Applications of different types of DC generator 3.4. DC Motor 3.4.1. Basic operating principle of a DC Machine as a Motor 3.4.2. Torque equation and back emf of a DC Motor 3.4.3. Types of DC motor • Shunt • Series and • Compound	

		3.4.3. DC Motor Starter and its necessity 3.4.4. Speed control of DC motor 3.4.5. Applications of different types of DC motor	
4	Three phase induction machines	4.1 Definition and functions of Induction Motor 4.1.1 Concept of Three phase Induction Motor 4.1.2. Functions of Three phase Induction Motor 4.2. Constructional details of Induction Motor 4.2.1. Construction features of an Induction Motor • Stator core • Stator winding • Yoke (Body) • Rotor- Squirrel cage and Phase wound(Phase Wound) 4.2.2. Differences between Squirrel Cage and Slip Ring (Phase Wound) three phase induction motors 4.3. Operation as motor 4.3.1. Concept of Synchronous speed, rotating magnetic field, rotor speed and slip 4.3.2. Operating principle of 3 phase Induction machines as a motor 4.3.3. Equivalent circuit of a three phase Induction Motor (standstill and running condition) 4.5. Torque – slip characteristics of a three phase induction motor 4.5.1. Concept of slip 4.5.2. Basic introduction to Torque and Slip Curve of three Phase Induction Motors (Mathematical interpretation not required) 4.6. Starting of Three phase Induction motors 4.6.1. General introduction of Three Phase Induction Motor Starter and its necessity	14

		4.6.2. Primary Rheostat method of three phase Induction Motor Starters 4.6.3. Star/Delta Starter method of three phase Induction Motor Starters 4.6.4. Auto Transformer method of three phase Induction Motor Starters 4.7. Speed control of three-phase induction motor 4.7.1. General introduction of Speed control of three-phase induction motor 4.7.2. Types of speed control methods of three-phase induction motors: • Stator voltage control method • Rotor rheostat method and • Frequency control method 4.8. Application of three-phase induction motors 4.9. Basic introduction to induction generator and its uses	
5	Synchron ous Machines	5.1. Definition and functions 5.1.1 Concept of Synchronous machines 5.1.2. Functions of Synchronous machines 5.2. Constructional details 5.2.1 Constructional features of Synchronous machines • Stator core • Stator winding • Rotor- Cylindrical rotor and Salient pole rotor • Field winding • Exciter 5.3. Operation as a generator 5.3.1. Operating principle of synchronous machines as a Generator	12

		5.3.2. Emf equation of synchronous machines as a Generator 5.3.3. Factors affecting the magnitude of emf 5.3.4. Relation between internal emf and terminal voltage of synchronous machines (circuit diagram and equation only) 5.4. Parallel operation and Synchronization of Alternators 5.4.1. Concept of Parallel operation of alternators 5.4.2. Requirement for parallel operation of alternators 5.4.3. Synchronization of Alternators • Dark Lamp Method • Synchrono scope Method 5.5. Synchronous motor 5.5.1 General introduction of a synchronous motor 5.5.2 Applications of a synchronous motor	
6	Single phase fractional horse power motors	6.1. Single phase induction motor 6.1.1. Basic introduction of Single phase induction motor 6.1.2. Constructional details of Single phase induction motor 6.1.3. Operation principle and basic concept of zero starting torque characteristic ofSingle phase induction motor 6.2. Methods of making single phase induction motor self-starting 6.2.1. Principle of self-starting of single phase motors 6.2.2. Methods of making single phase induction motor self-starting • Split phase induction motor Capacitor start, capacitor run, capacitor start	10

		and run motor • Shaded pole motor 6.2.3. Construction working principle and operation of all types ofSingle phase induction motors 6.2.4. Applications and advantages of Shaded pole motor 6.4. Single phase series motor or universal motor 6.4.1. Basic introduction of Single phase series motor and universal motor 6.4.2. Applications and advantages of Single phase series motor and universal motor	
	Total		64

5. Suggested Practical and Project Works

The practical and project works are integral parts of reinforcing the students' learning. So the new curriculum provisions the practical and projects works as a part of curriculum. Some of the sample practical and project works are suggested herewith. However, a teacher can adapt them or use similar other project works as per their students need and specific context.

S.N.	**Grade 10**		
	Content Area	**Practical Activities**	**Hrs.**
2	Transformer	2.1.Familiarize with different core section and parts of transformer. 2.2.Calculate turn ratio in a 220/12 V transformer. 2.3 Demonstrate the different parts of a pole mounted distribution transformer via animated videos and site visit. 2.4 Demonstrate the different parts of a power transformer via animated videos and site visit. 2.5 Short circuit and open circuit test of a	**10**

		transformer. 2.6 Field visit to a transformer manufacturing or repairing company	
3	DC Machines	3.1. Familiarization with different parts of dc machine and run it as motor and generator 3.2 Assembling a dc motor starter and test it. 3.3. Speed control of DC shunt motor by armature control and flux control method.	**5**
4	Three phase induction machines	4.1 Familiarization with different parts of three phase induction motor and run it as motor. 4.2. Connection of a three phase induction motor in star and delta connection manually 4.3. Assembling auto-transformer starter and test it. 4.4. Assembling Star-Delta starter and test it. 4.5. Perform no load test and blocked rotor test on an induction motor 4.6. Reverse the direction of a motor by phase reversal method	**16**
5	Synchronous Machines	5.1. Familiarization with the different parts of three phase synchronous machine 5.2. Determination of the regulation and efficiency of alternator from the open circuit and short circuit test 5.3. Observation of synchronization of Alternators in a nearby hydro power station 5.4. Field visit to a nearby power plant	**18**
6	Single phase fractional horse power motors	6.1. Identification of different parts of different single phase motors 6.2. Connections of single phase motors	**15**

		6.3. Change of direction of a single phase capacitor start motor 6.4. Assembling de-assembling of split-phase single phase induction motor and run it. 6.5. Assembling de-assembling of capacitor start and run a single phase induction motor and run it.	
	Total		**64**

6. Learning Facilitation Process

This course aims to blend both theoretical and practical aspects of knowledge and skills required in the subject. So, its facilitation process differs from the traditional method of delivery. The practical aspect is much more focused. So, methods and strategies that enable the practical skills in the students are much used in course of content facilitation. A facilitator encourages and assists students to learn for themselves engaging in different activities with practical tasks. To achieve the entire objectives from this syllabus, the teacher must use different techniques and process while teaching. In particular, the teacher can make use of the following methods and strategies for the learning facilitation:

- Discussion
- Demonstration
- Presentation
- Audio/Visual Classes
- Practical works
- Project works
- Field study
- Group works and pair works
- Exploration

7. Student Evaluation

Evaluation is an integral part of learning process. Both formative and summative modes

of evaluation are emphasized. Formative evaluation will be conducted so as to provide regular feedback for students, teachers and parents/guardians about how student learning is. Class tests, unit tests, oral question-answer, home assignment etc, are some ways of formative evaluation.

There will be separate evaluation of theoretical and practical learning. Summative evaluation embraces theoretical examination, practical examination and evaluation of research work or innovative work.

(a) Internal Evaluation

Internal evaluation covers 50 Percent weight age. Internal evaluation consists of Practical Activities (Practical works and projects works) (35 Percent), (b) Marks from trimester examinations (10 Percent), and (c) Classroom participation (5 Percent). Practical work should be based on list of activities mentioned in this curriculum. Project works should be based on the mentioned lists or created by teachers. Mark distribution for internal evaluation (practical work and project work) will be as follows:

S.N.	Mani activities	Activities in detail	Percent
1	Participation	Participation in attendance, homework, classwork, project work, practical works etc.	5
2	Practical work	Conduction of practical work activities	15
		Record keeping of practical work activities	3
3	Project work	Conduction of project work activities	10
		Record keeping of project work activities	2
4	Viva	Viva of practical work and project work activities	5
6	Internal exam	First trimester 5 marks and Second trimester 5 marks	10
Total			50

Note:

(i) Practical examination will be conducted in the presence of internal and external supervisors. Evaluation of experiment will focus both the product of work and

skills competencies of student in using apparatus.

(ii) Project work assessment is the internal assessment of reports and presentation of their project works either individually or group basis. In case of group presentation, every member of the group should submit a short reflection on the presented report in their own language. Records of project works must be attested by external supervisor.

(b) External Evaluation

There will be an external theoretical evaluation which covers 50% of marks. The tool for external evaluation of theoretical learning will be a written examination. Questions for the external examination will be based on the specification grid developed by Curriculum Development Centre. Examination question paper will be developed using various levels of revised Bloom's taxonomy including remembering level, understanding level, application level and higher ability (analyzing, evaluating, creating).

Specification Grid

Grade: 9 Subjects : Basic Electrical Engineering Time : 2 hrs.

Unit	Content	Credit hrs.	Knowledge and Understand			Application			Higher Ability			Total Question Number			Total Question	Marks Weight			Total Marks
			MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long		MCQ	Short	Long	
1	Electromagnetism	6	5	1	0	4	4	1	0	0	1	9	5	2	16	9	25	16	4
2	Transformer	14																	12
3	DC Machines	8																	6
4	Three phase induction machines	14																	10
5	Synchronous Machines	12																	10
6	Single phase fractional horse power motors	10																	8
	Total	64	5	1	0	4	4	1	0	0	1	9	5	2	16	9	25	16	50

Basic Electronics

Grades: 10 **Credit hrs: 4** **Working hrs: 128**

1. Introduction

Basic electronics comprises the minimal electronics components that make up a part of everyday electronics equipment. These electronic components include resistors, transistors, capacitors, diodes, inductors and transformers. Powered by a battery, they are designed to work under certain physics laws and principles. This course is designed to provide students with general understanding of the different aspects of basic electronics.

The curriculum comprises of the contents like passive components, basics of semiconductor, semiconductor diode, power supplies, transistors, field effect transistors and logic gates. The course itself is of practical nature and the pedagogical approaches in delivering the course should consider the balance between theory and practice. The course will impart the student not only the basic knowledge and skills in the various aspects of Basic Electronics but also inculcate them service culture, self-discipline, teamwork, problem-solving, communication and presentation skills.

The curriculum is structured in accordance with National Curriculum Framework, 2076. It focuses on both theoretical and practical aspects having equal teaching and practical. It incorporates the level-wise competencies, grade-wise leaning outcomes, scope and sequence of contents, suggested practical/project activities, learning facilitation process and assessment strategies so as to enhance the learning on the subject systematically.

2. Competencies

On completion of the course, the students will have developed the following competencies:

1. Identify the passive components
2. Gain basic knowledge of semiconductor and semiconductor devices
3. Acquire skills on DC power supplies
4. Develop a concept of transistor
5. Apply transistors in electronic projects

6. Classify logic gates.

3. Grade-wise Learning Outcomes

S.N.	Content Area	Learning Outcomes
1	Passive Components	1.1 Introduce Resistors. 1.2 Introduce Capacitors. 1.3 Introduce Inductor.
2	Basics of Semiconductor	2.1 Introduce semiconductor and characteristics. 2.2 Define energy levels, energy bands, energy gap. 2.3 Identify Hole and electron current. 2.4 List out the types of semiconductor p-type). 2.5 Identify majority and minority charge carrier. 2.6 Find effects of temperature on conductivity of semiconductor.
3	Semiconductor Diode	3.1 Introduce PN junction. 3.2 Identify Depletion region, depletion layer, energy barrier potential. 3.3 Introduce biasing. 3.4Introduce PN diode. 3.5 Define Reverse breakdown effects, Avalanche, Zener and thermal breakdown. 3.6 Introduce various diodes.
4	**Power supplies**	4.1Introduce rectifier. 4.2 Describe rectifier circuits. 4.3 Show block diagram of power supplies.
5	Transistors	5.1 Introduce transistor. 5.2 Define Bipolar Junction transistor (BJT). 5.3 Introduce NPN and PNP transistors. 5.4 Identify Configurations of BJT. 5.5 Introduce photo transistor.

6	Field Effect Transistors	6.1 Introduce field effect transistors. 6.2 Introduce Metal Oxide Semiconductor Field Effect Transistor (MOSFET).
7	Logic Gates	7.1 Introduce Digital System. 7.2 Identify Binary system. 7.3 Introduce logic gates. 7.4 Perform Boolean Algebra.

4. Scope and Sequence of Contents

S.N.	Content Area	Elaboration of Contents	Hrs.
1	Passive Components	1.1 Resistors- Definition, types, characteristics, color code, resistance, applications 1.2 Capacitors- Definition, types, characteristics, numeric code, capacitance, applications 1.3 Inductor- Definition, types, characteristics, color code, inductance, applications 1.4 Simple numerical related to resistor color code and capacitor numeric code	8
2	Basics of Semiconductor	2.1 Introduction of semiconductor and its properties 2.2 Bonds in semi-conductor and its crystal structure 2.3 Semiconductor materials(Germanium and Silicon) and characteristics 2.4 Definition of energy levels, energy bands, energy gap 2.5 Hole and electron current 2.6 Types of semiconductor (Intrinsic, Extrinsic-N-type, p-type) 2.7 Majority and minority charge carrier 2.8 Effects of Temperature on Conductivity of Semiconductor	8

3	Semiconductor Diode	3.1 PN junction 3.2 Depletion region, depletion layer, energy barrier potential 3.3 Introduction of PN junction biasing 2.3.1 Forward biased 2.3.2 Reverse biased 3.4 PN diode- Definition, electric symbol and its applications 3.5 Reverse breakdown effects, Avalanche, Zener and Thermal breakdown 3.6 Introduction and applications of various diodes 3.6.1 Zener diode 3.6.2 LED (Light Emitting Diode) 3.6.3 Power diode 3.6.4 Varactor diode 3.6.5 Photo diode	10
4	Power supplies	4.1 Definition of rectifier and its components 4.2 Basic rectifier circuits, types (half wave, center tapped and bridge full wave rectifier), working principle, characteristics and applications 4.3. Rectifier circuits with filter 4.3 Overall block diagram of power supplies	12
5	Transistors	5.1 Definition of transistor, basic classification of transistors (BJT, FET) 5.2 Bipolar Junction transistor(BJT) 5.2.1 Definition of BJT, regions, junctions and terminals of BJT 5.2.2 Types of BJT (NPN, PNP) 5.2.3 Working principle of NPN and PNP transistors	8

		5.2.4 Configurations of BJT 5.2.5Applications of BJT 5.3 Working principle of NPN and PNP transistors, circuit characteristics 5.4 Configurations of BJT(CB,CE,CC) 5.5 Characteristics of BJT (input output and transfer) 5.6 Applications of BJT 5.7 Demonstration of various types of Transistors, Transistor Rating and Interpretation of Transistor Data sheet 5.8 Explain photo transistor, characteristics and application.	
6	Field Effect Transistors	6.1 Explain the field effect transistors(definition and basic classification- JFET,MOSFET 6.2 Junction field effect transistors(JFET) 6.2.1Definition, classification of JFET 6.2.2Regions, structure, symbol of JFET 6.2.3 Basic working principle of N-channel and P-channel JFET 6.2.4Applications of JFET 6.3 Metal Oxide Semiconductor Field Effect Transistor (MOSFET) 6.3.1Definition, classification of MOSFET 6.3.2Regions, structure, symbol of MOSFET 6.2.3Basic working principle of N-channel and P-channel JFET 6.2.4Applications of MOSFET	8
7	Logic Gates	7.1 Introduction to Digital System 7.2 Binary system(addition, subtraction ,multiplication) 7.3 Introduction to logic gates	10

		7.4 Types of logic gates 7.4.1 OR 7.4.2 NOR 7.4.3 AND 7.4.4 NAND 7.4.5NOT 7.4.6XOR 7.5 Truth Table 7.6 Boolean Algebra 7.7 Applications of logic gates	
	Total		64

5. Suggested Practical and Project Works

The practical work that students do during their course is aimed at providing them learning opportunities to accomplish competency of the curriculum as well as reinforcing their learning of the theoretical subject content. Similarly, involving in a project work fosters the self-learning of students in the both theoretical and practical contents. As this subject emphasizes to develop both theoretical and practical knowledge and skills, some of the practical and project works are suggested for the students. However, the tasks presented here are the samples only. A teacher can assign the extra practical and project works as per the students' need or specific context.

Unit	**Grade 10**		
	Content Area	**Practical Activities**	**Hrs.**
1	Passive Components	1.1 Familiarization with the tools, equipment and materials used in electronics laboratory 1.2 Demonstrate the basic working of a multimeter and breadboard. 1.3 Calculate the value of resistor using color code and compare the values to that of measured with multimeter. 1.4 Identification of different types of resistors,	6

		inductors and capacitors 1.5 Calculate the value of capacitor using numeric code and compare the values to that of measured with multimeter. 1.6 Calculate the equivalent resistance of resistors, capacitance of capacitors, and inductance of inductors when they are connected in series and parallel by using multimeter.	
2	Basics of Semiconductor	2.1 Demonstrate animated videos of extrinsic semiconductor and PN junction. 2.2 Demonstrate videos of PN Junction diode working.	6
3	Semiconductor Diode	3.1 Demonstrate a simple circuit in bread board using a battery, resistor, PN diode LED in both forward and reverse biased mode. 3.2 Assess Diode forward IV Characteristics and also observe it in oscilloscope. 3.3 Assess zener diode reverse IV characteristics. 3.4 Identify different types of diodes and their terminals. 3.5 Use of diodes in a circuit. **3.6** Use of semiconductor manuals.	10
4	Power supplies	4.1 Assess half wave rectifier in breadboard and observe input and output waveform in oscilloscope. 4.2 Assess center tapped and bridge full wave rectifier circuits in a breadboard and observe its input and output waveform in oscilloscope. 4.3 Assess Zener voltage Regulator. 4.4 Fabricate 12V DC output bridge type rectifier	**18**

		circuits in a matrix board. 4.5 Fabricate 12V DC output power supply using rectifier, filter and voltage regulating components in a matrix board.	
5	Transistors	5.1 Identify the transistor's terminals by using datasheet and multimeter. 5.2 Demonstrate BJT works as a switch. 5.3 Plotting of input and output characteristics of a BJT in CE configuration 5.4 Design, testing and fabrication of Basic circuits using transistors like Automatic Street Light controller, Burglar alarm circuit, Clap switch, etc. 5.5 Fabrication of BJT circuits in a matrix board	**9**
6	Field Effect Transistors	6.1 Identify the terminals of a FET. 6.2 Demonstrate FET as a switch.	**3**
7	Logic Gates	7.1 Perform AND, OR and NOT logic using TTL. 7.2 To verify the Truth Tables of AND, OR, NOT, NAND, NOR and XOR logic gates using Students' Kit 7.3 To verify the Truth Tables of AND, OR, NOT, NAND, NOR and XOR logic gates using Components: IC 7400, 7402, 7404,7408,7432,7486 7.4 Projects using Logic gate ICs	**12**
	Total		**64**

6. Learning Facilitation Method and Process

Learning facilitation process is the crux of the teaching and learning activity. One topic can be facilitated through two or more than two methods or processes. The degree of usage will be based on the nature of the content to be facilitated. However, a teacher

should focus on methods and techniques that are more students centered and appropriate to facilitate the content. The following facilitation methods, techniques and strategies will be applied while conducting the teaching learning process:

- Demonstration
- Presentation
- Practical works
- Project works
- Field study/ Field Visit
- Discussions
- Group works and pair works
- Questionnaire
- Audio/Visual Classes

7. Student Evaluation

Evaluation is an integral part of learning process. Both formative and summative modes of evaluation are emphasized. Formative evaluation will be conducted so as to provide regular feedback for students, teachers and parents/guardians about how student learning is. Class tests, unit tests, oral question-answer, home assignment etc, are some ways of formative evaluation.

There will be separate evaluation of theoretical and practical learning. Summative evaluation embraces theoretical examination, practical examination and evaluation of research work or innovative work.

(a) Internal Evaluation

Internal evaluation covers 50 Percent weight age. Internal evaluation consists of Practical Activities (Practical works and projects works) (35 Percent), (b) Marks from trimester examinations (10 Percent), and (c) Classroom participation (5 Percent). Practical work should be based on list of activities mentioned in this curriculum. Project works should be based on the mentioned lists or created by teachers. Mark distribution for internal evaluation (practical work and project work) will be as follows:

S.N.	Mani activities	Activities in detail	Percent
1	Participation	Participation in attendance, homework, classwork, project work, practical works etc.	5
2	Practical work	Conduction of practical work activities	15

		Record keeping of practical work activities	3
3	Project work	Conduction of project work activities	10
		Record keeping of project work activities	2
4	Viva	Viva of practical work and project work activities	5
6	Internal exam	First trimester 5 marks and Second trimester 5 marks	10
Total			50

Note:

(i) Practical examination will be conducted in the presence of internal and external supervisors. Evaluation of experiment will focus both the product of work and skills competencies of student in using apparatus.

(ii**)** Project work assessment is the internal assessment of reports and presentation of their project works either individually or group basis. In case of group presentation, every member of the group should submit a short reflection on the presented report in their own language. Records of project works must be attested by external supervisor.

(b) External Evaluation

Theoretical evaluation covers 50% of the weight. The tool for external evaluation of theoretical learning will be a written examination. Questions for the external examination will be based on the specification grid developed by Curriculum Development Centre. Examination question paper will be developed using various levels of revised Bloom's taxonomy including remembering level, understanding level, application level and higher ability (analyzing, evaluating, creating).

Specification Grid

Grade: 9 Subjects : Basic Electrical Engineering Time : 2 hrs.

Unit	Content	Credit hrs.	Knowledge and Understand			Application			Higher Ability			Total Question Number			Total Question	Marks Weight			Total Marks
			MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long		MCQ	Short	Long	
1	Passive Components	8	6	1	0	3	3	1	0	1	1	9	5	2	16	9	25	16	6
2	Basics of Semiconductor	8																	6
3	Semiconductor Diode	10																	8
4	Power supplies	12																	10
5	Transistors	8																	6
6	Field Effect Transistors	8																	6
7	Logic Gates	10																	8
	Total	64	6	1	0	3	3	1	0	1	1	9	5	2	16	9	25	16	50

Industrial Installation & Maintenance

Grades: 10 Credit hrs: 4 Working hrs: 128

1. Introduction

Industrial installation and maintenance is a course that helps students develop the skills related to industrial installation and maintenance. This course gives knowledge in electrical distribution system of three phase in industry, use of three phase and single phase system in our daily life. It helps to understand the concept of power supply unit. It also enhances the knowledge about the induction motor and protective devices. It includes an introduction to the field as well as fundamentals of safety in installation and maintenance. Beside these students are able to perform connection on panel board, distribution board through panel board and enhance the knowledge about the earthing and its type.

This curriculum includes the contents of fire and safety standards, inspection, testing and maintenance of industrial installations, earthing arrangements and Lightning Protection System of distribution system, distribution system in industrial installations, industrial wiring and three phase Induction Motor Controls. This course gives student's real-world, hands-on practice in these areas.

The curriculum prepared in accordance with National Curriculum Framework is structured for two academic years in such a way that it incorporates the level-wise competencies, grade-wise leaning outcomes, scope and sequence of contents, suggested practical/project activities, learning facilitation process and assessment strategies so as to enhance the learning on the subject systematically.

2. Competencies

On completion of the course, the students shall develop the following competencies:

1. Apply the safety requirements for industrial wiring practices
2. Apply the distribution system in industrial installations
3. Apply the skills in industrial wiring installations
4. Acquire and apply the knowledge about earthing arrangements

5. Conduct a standard inspection and testing of industrial installations
6. Acquire and use the skills in motor control in industrial practices.

3. Grade-wise Learning Outcomes

S.N.	Content Area	Learning Outcomes
1	Fire and Safety Standards	1.1. Introduce Codes of Practice for Electrical Wiring Regulations. 1.2. Introduce Electric Safety signs and Colors as per standards. 1.3. Introduce Personal Protective Equipment: IS-3. 1.4. Introduce firefighting and fire suppression equipment.
2	Distribution system in Industrial Installations	2.1. Introduce Distribution system. 2.2. Identify Electrical drawing symbols and legends. 2.3. Introduce Single line diagram of Distribution Lines. 2.4. Install Aluminum Conductor Steel Reinforced(ACSR) and Aerial Bundled Conductors (ABC) in feeders and Distributors. 2.5. Introduce Distribution Switchgear. 2.6 Describe Pole Mounted Substation. 2.7 Introduce Jointing techniques and Terminations of Overhead andunderground Cables.
3	Industrial Wiring	3. 1 Introduce industrial wiring 3.2. Introduce Panel Boards and Distribution Boards. 3.3. Describe Cable Management System. 3.4. Install motors. 3.5. Improve Power Factor.
4	Earthing arrangements of Distribution	4.1. Introduce Earthing of electric equipment. 4.2.Introduce System Earthing. 4.3 Provide concept of Lightning Protection System.

	System	
5	Inspection, Testingand Maintenance of Industrial Installations	5.1 Inspect industrial installations. 5.2. Test industrial installations.
6	Three phase Induction Motor Controls	6.1. Control three phase induction motor using Drum Switches. 6.2. Introduce functions and applications of motor Control accessories. 6.3. Describe power and control circuit diagrams of simple motor control system.

4. Scope and Sequence of Contents

S.N.	Content Area	Elaboration of Contents	Hrs.
1.	Fire and Safety Standards	1.1. Codes of Practice for Electrical Wiring Regulations: 1.1.1. Protection againstElectric Shock 1.1.2. Protection against Thermal Effects 1.1.3. Protection against Overcurrent 1.1.4. Protection against Fault currents 1.2. Electric Safety signs and Colors 1.2.1 Electrical Safety Signs • Prohibition Signs • Mandatory Signs • Mandatory Actions Signs • Warning Signs • Safe Condition Signs • Supplementary Signs 1.1.1. Safety symbols 1.1.2. Safety colors	

		1.2.Personal Protective Equipment PPE-1 Helmets, PPE-2 Safety Footwear, PPE-3 Respiratory Protective Equipment, PPE-4 Arm and Hand Protection, PPE-5 Eye and Face Protection, PPE-6 Protective Clothing and Coverall, PPE-7 Ear Protection, PPE-8 Safety Belts and Harnesses 1.4. Firefighting and fire suppression equipment 1.4.1. Concept and importance of Firefighting and fire suppression equipment 1.4.2. Classification of fires 1.4.3. Firefighting and fire suppression equipment 1.5. Lock Out-Tag Out (LOTO) and Permit to Work (PTW) 1.5.1. Concept and Necessity of Lock Out-Tag Out 1.5.2. Concept and Necessity of PTW System	**6**
2	Distribution system	2.1. Introduction to Distribution system 2.1.1 Types of Distribution System • Primary Distribution System • Secondary Distribution System 2.1.2. Single phase and three phase Power Supply syste 2.1.3. Three phase four wire system 2.1.4. Star and Delta Connections 2.2. Electrical drawing symbols and legends 2.2.1. Drawings, specifications and standards 2.2.2. NEA distribution rules & regulations and 11 KV and 400/230 V overhead line 2.3. Single line diagram of Distribution Lines 2.3.1. Single line diagram of 11KV to end users 2.3.2. NEA 11 KV and 400V/230V overhead line construction 2.4. Installation of Aluminum Conductor Steel Reinforced(ACSR) and Aerial Bundled Conductors	**14**

		(ABC) infeeders andDistributors 2.5. Definition and Need of Distribution Switchgear 2.5.1. Medium Voltage Switchgear 2.5.2.1. Knife Switches 2.5.2.2. Load Break Switches(with fuse and with 2.5.2.3. Earthing Switches 2.5.2.4. Circuit Breakers (ACB, VCB, OCB CB) 2.5.2. Low Voltage Switchgear 2.5.3.1. Isolators 2.5.3.2. Load Break Switches (LBS) 2.5.3.3. Contactors 2.5.3.4. Fuse Switch 2.5.3.5. LV Circuit Breakers (MCB, MCCB and 2.5.3. Protective and Control Devices (Bus bars, Isolating links, Earthing links, CBs, Instrument transformers (current and voltage), Protective relays and Lightning arresters) 2.6 Pole Mounted Substation 2.6.1. Introduction to Pole Mounted Substation 2.6.2. Main components of Pole Mounted Substation(Li Arrestor, Gang Operated(GO) Switch, Drop Out Fuse, L Arrestor, Transformer, MCCB, Busbars and Cables) 2.7 Jointing techniques and Terminations of Overhead a Underground Cables 2.7.1. Jointing techniques of Overhead and Undergroun 2.7.2. Terminations of Overhead and Underground Cabl	
3	Industrial Wiring	3.1.Basics of Industrial Wiring as per NBC 3.2. Panel Boards and Distribution Boards 3.3. Cable Management System 3.4. Types of Cable Joints(Straight through Joints, T-Jo	**12**

		Brittania Joint, Married Joints, Sleeve Joint and Compre 3.5. Installation of Motors 3.6. Power Factor Improvement 3.6.1. Importance of Power Factor Improvement 3.6.2. Use of Power Factor Correction devices(APFC ar Static Capacitors)	
4	Earthingarrangements of Distribution System	4.1. Earthing of Electric Equipment 4.1.1. Equipment and Neutral Earthing 4.1.2 Substation Earthing 4.1.2.1. Step and Touch Voltage Regulations 4.1.2.2. Substation Earthing Mats 4.2.System Earthing 4.2.1. Definition and purpose of System Earthing 4.2.2. Earthing Arrangements in Medium Voltage System • Unearthed Neutral System • Earthed Neutral System	**10**
5	Inspection, Testingand Maintenance of Industrial Installations	5.1 Inspection of Industrial Installations 5.1.1. Inspection of Industrial Wiring system 5.1.2. Inspection of Industrial Equipment 5.2. Testing of Industrial Installations 5.2.1. Test instruments • Insulation Test Instruments • Continuity Test Instruments • Phase sequence Test Instruments • Earth resistance Test Instruments 5.2.2 Testing • Insulation Test • Continuity Test • Earth Resistance Test • Earth Continuity Test	**8**

6	Three phase **Induction Motor Controls**	6.1. Control of three phase induction motor using Drum Switches 6.1.1. Control of three phase induction motor using simple drum type ON/OFF switch 6.1.2. Control of three phase induction motor using simple drum type forward/reverse switch 6.1.3. Control of three phase induction motor using simple drum type star/delta switch 6.2. Functions and applications of Motor Control Accessories 6.2.1. Functions and applications of Motor Control Accessories : Contactor, Motor Protection Circuit Breaker (MPCB), Over Load Relay (OLR), Push button switches, Timers etc. 6.3. Power and control circuit diagrams of simple motor control system 6.3.1. Power and control circuit diagrams of simple motor control system (Inching and Holding System) 6.3.2. Power and control circuit diagrams of simple motor control system from two places 6.3.3. Power and control circuit diagrams of simple motor control system in two directions	**14**

		6.3.4. Power and control circuit diagram of motor sing star delta starter	
	Total		**64**

5. Suggested Practical and Project Works

Practical and project work is an integral part of technical and vocational subjects. They are carried out to consolidate the practical learning experiences. Some of the suggested practical and project work activities of this subject are mentioned below. As these are the basic and fundamental practical and project works, the teacher can adapt or introduce more relevant to their context and students' needs.

S.N.	**Grade 10**		
	Content Area	**Suggested Practical Activities**	**Hrs.**
2	Distribution system in Industrial Installations	2.1 Install 3-phase 4 wire supply system for single phase and 3 phase distribution board. List of main parts ➢ Incomer 32ATPMCB ➢ Outgoing 16ATPMCB ➢ Outgoing 16ASPMCB ➢ Outgoing 6ASPMCB ➢ Earth connector ➢ Neutral Connector 2.2. Field visit to nearby industrial installations. 2.3. Study and identify the components of a pole mounted substation. 2.4. Identify the different types of secondary distribution system. 2.5. Study of three phase four wire system.	**6**
3	Industrial Wiring	3.1 Performing tripping of MCB and blowing of fuse. 3.2 Observation of different types of circuit	**6**

		breakers and report writing 3.3. Field visit to a nearby industrial building. 3.4. Study the components of industrial panels.	
4	Earthing arrangements	3.1 Observation of different methods of earth electrodes 3.2 Testing of earth resistance using dedicated tester	**6**
5	Inspection, Testingand Maintenance of Industrial Installations	2.1. Perform the types of testing process. a. Continuity test b. Polarity test of switch, MCB and battery c. Insulation test –Between conductors – Between conductor and earth d. Earth resistance test in domestic system by earth tester	**4**
6	Three phase Induction Motor Controls	6.1 Connect and run three phase induction motor using simple drum type ON/OFF switch. 6.2 Connect and run three phase induction motor in both directions using simple drum type forward/reverse switch. 6.3 Connect and run three phase induction motor using simple drum type Star/Delta switch. 6.4 Draw power and control circuit diagram of simple motor control system. And run using following accessories. ➢ Air break contactor - 1 Nos ➢ OLR – 1 NOs ➢ TPMCB32A – 1 Nos ➢ SPMCB6A – 1Nos	**42**

		➢ Push Button switch(start/stop) – 2 Nos 6.5 Draw power and control circuit diagram of simple motor control system from two places. And run using following accessories. ➢ Air break contactor - 1 Nos ➢ OLR – 1 NOs ➢ TPMCB32A – 1 Nos ➢ SPMCB6A – 1Nos ➢ Push Button switch(start/stop) – 3 Nos 6.6 Draw power and control circuit diagram of simple motor control system in two directions. And run using following accessories. ➢ Air break contactor - 2 Nos ➢ OLR – 1 NOs ➢ TPMCB32A – 1 Nos ➢ SPMCB6A – 1Nos ➢ Push Button switch(start/stop) – 3 Nos 6.7 Draw power and control circuit diagram of star delta motor stator. And run using following accessories. ➢ Air break contactor - 3 Nos ➢ OLR – 1 NOs ➢ TPMCB32A – 1 Nos ➢ SPMCB6A – 1Nos ➢ Push Button switch(start/stop) – 3 Nos	
	Total		**64**

6. Learning Facilitation Process

This course intends to provide both theoretical as well as practical knowledge and skills

on the subject, thereby, blends with both theoretical and practical facilitation strategies to ensure better learning. In fulfilling the learning outcomes stated in the curriculum, the teacher should use a variety of methods and techniques that fit to the contents. In particular, the following methods, techniques and strategies are used for learning facilitation:

- Demonstration
- Case study
- Practical Works
- Audio/Visual use from different sources
- Project Works
- Problem Solving
- Field Visit
- Discussion
- Group works and pair works

7. Student Evaluation

Evaluation is an integral part of learning process. Both formative and summative modes of evaluation are emphasized. Formative evaluation will be conducted so as to provide regular feedback for students, teachers and parents/guardians about how student learning is. Class tests, unit tests, oral question-answer, home assignment etc, are some ways of formative evaluation.

There will be separate evaluation of theoretical and practical learning. Summative evaluation embraces theoretical examination, practical examination and evaluation of research work or innovative work.

(a) Internal Evaluation

Internal evaluation covers 50 Percent weight age. Internal evaluation consists of Practical Activities (Practical works and projects works) (35 Percent), (b) Marks from trimester examinations (10 Percent), and (c) Classroom participation (5 Percent). Practical work should be based on list of activities mentioned in this curriculum. Project

works should be based on the mentioned lists or created by teachers. Mark distribution for internal evaluation (practical work and project work) will be as follows:

S.N.	Mani activities	Activities in detail	Percent
1	Participation	Participation in attendance, homework, classwork, project work, practical works etc.	5
2	Practical work	Conduction of practical work activities	15
		Record keeping of practical work activities	3
3	Project work	Conduction of project work activities	10
		Record keeping of project work activities	2
4	Viva	Viva of practical work and project work activities	5
6	Internal exam	First trimester 5 marks and Second trimester 5 marks	10
Total			50

Note:

(i) Practical examination will be conducted in the presence of internal and external supervisors. Evaluation of experiment will focus both the product of work and skills competencies of student in using apparatus.

(ii) Project work assessment is the internal assessment of reports and presentation of their project works either individually or group basis. In case of group presentation, every member of the group should submit a short reflection on the presented report in their own language. Records of project works must be attested by external supervisor.

(b) External Evaluation

Theoretical evaluation in the subject covers 50% of the weight. The tool for external evaluation of theoretical learning will be a written examination. Questions for the external examination will be based on the specification grid developed by Curriculum Development Centre. Examination question paper will be developed using various levels of revised Bloom's taxonomy including remembering level, understanding level, application level and higher ability (analyzing, evaluating, creating).

Specification Grid

Grade: 9 Subjects : Basic Electrical Engineering Time : 2 hrs.

Unit	Content	Credit hrs.	Knowledge and Understand			Application			Higher Ability			Total Question Number			Total Question	Marks Weight			Total Marks
			MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long		MCQ	Short	Long	
1	Fire and Safety Standards	6	6	3	0	3	2	1	0	0	1	9	5	2	16	9	25	16	4
2	Distribution system	14																	12
3	Industrial Wiring	12																	10
4	Earthingarrangements of Distribution System	10																	8
5	Inspection, Testingand Maintenance of Industrial Installations	8																	6
6	Three phase Induction Motor Controls	14																	10
	Total	64	6	3	0	3	2	1	0	0	1	9	5	2	16	9	25	16	50

Utilization of Electrical Energy

Grades: 10 Credit hrs: 4 Working hrs: 128

1. Introduction

This curriculum of utilization of electrical electricity provides basic knowledge and concept on use of electrical energy. It gives the basic knowledge about the generation, transmission, distribution and utilization of electrical energy. It also gives the idea related to the application of electrical energy. This course also describes different types of illuminaries, their working principle and the applications. It also gives the effective knowledge about the types of lighting schemes. Beside these it gives concept about the power factor and its need of improvement.

This curriculum comprises of different contents related to utilization of electrical energy, Illumination, industrial utilization of electrical energy, traction system, power factor and tariff. The course itself is of practical nature and the pedagogical approaches in delivering the course should consider the balance between theory and practice. The course will impart the student not only the basic knowledge and skills in the various aspects of utilization of electrical energy but also inculcate them service culture, self-discipline, teamwork, problem-solving, communication and presentation skills.

The curriculum prepared in accordance with National Curriculum Framework is structured in such a way that it incorporates the level-wise competencies, grade-wise leaning outcomes, scope and sequence of contents, suggested practical/project activities, learning facilitation process and assessment strategies so as to enhance the learning on the subject systematically.

2. Competencies

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

1. Explain about the electrical energy and its application
2. Demonstrate different types of luminaries
3. Design a basic electrical installation.
4. Acquire and use skills about different types of drives.

5. Explain about electric traction system and tariff systems.
6. Understand concept of power factor and apply the ways to improve it.

3. Grade-wise Learning Outcomes

S.N.	Content Area	Learning Outcomes
1	Introduction to electrical energy	1.1. Introduce electrical energy and its applications.
2	Illumination	2.1. Describe Electromagnetic waves. 2.2. Introduce Illumination terminologies and laws. 2.3 Describe Luminaries and lamps. 2.4. Provide concept of Glare. 2.5 Describe the concept of illumination design.
3	Industrial Utilization of Electrical Energy	3.1. Introduce the role of electrical energy in modern industry. 3.2 Identify function of drives. 3.3 List out the different types of drives. 3.4. Select various types of drives. 3.5. List the factors for selecting the motors. 3.6. Identify types of motors for particular service.
4	Traction System	4.1. Provide concept of traction. 4.2. Introduce system of traction. 4.3. List advantages and disadvantages of Traction. 4.4. Listthe types of electrical vehicles. 4.5 Differentiate AC over DC supply system. 4.6. Identify drive of tramways, trolley buses, electric trains. 4.7. Introduce braking of traction motor.
5	**Power factor**	5.1. Introduce power factor. 5.2. Describe the Causes of low power factor.

		5.3. Describe the effect of low power factor. 5.4. Enlist advantages of power factor correction. 5.5.. List methods of improving power factor
6	Tariff	6.1.Introduce tariff system 6.2. List the objectives of tariff. 6.3. Describe the calculating methods of tariff. 6.4. List the types and application of tariff. 6.5. Introduce the tariff system in Nepal

4. Scope and Sequence of Contents

S. N.	Content Area	Elaboration of Contents	Hrs.
1.	Introduction to electrical energy	1.1. Use of electrical energy (4) 1.1.1. Provide the concept of Electrical Energy. 1.1.2 Types of Electrical Energy according to as per using • Domestic • Commercial • Industrial • Agricultural • Irrigation (Water supply) • Traction 1.2. Advantage of electrical energy over other form of energy.	4

2.	Illumination	2.1. Electromagnetic waves light and heat (2) 2.1.1. Provide the concept of heat and light and their differences. 2.1.2. Electromagnetic Wave. 2.1.3. Visible range of wave spectrum. 2.1.4 Ultraviolet and infrared rays. 2.1.5 Unit of wave length. 2.2. Illumination terminologies and laws. (4) 2.2.1. Illumination level, luminous flux, luminous intensity, brightness or luminance, solid angle, candela power etc. 2.2.2. Formulae of Illumination level and luminous intensity. 2.2.3. Laws of Illumination. • Inverse square law • Lamberts cosine law 2.2.4. Use and application of Illuminations. 2.3 Luminaries and lamps (10) 2.3.1 Filament lamp (incandescent filament lamp) • Construction detail and working principle • Efficiencies • Merits and demerits and application 2.3.2. Gaseous discharge lamp (Sodium vapor, High pressure mercury vapor, Neon tube, Fluorescent tube lamps) • Construction detail and working principle • Efficiencies • Merits and demerits and application 2.3.3 LED light	28

		2.3.4 Stroboscopic effect and reduction technique 2.3.5 Comparison of various lamp 2.3.4 Reflector and Diffuser 2.4. Glare (2) 2.4.1. Phenomena of glare. 2.42. Effect of glare. 2.4.3. Reduction technique of glare. 2.5 Illumination design (12) 2.5.1 Types of lighting scheme • Direct lighting9 • Semi-direct lighting • Indirect lighting • Semi-indirect lighting 2.5.2 Requirement of well-designed lighting • Illumination level • Uniformity • Color of light • Shadows and glare • Mounting height spacing • Color of surrounding wall 2.5.3. Space height ratio, coefficient of utilization, maintenanceand depreciation factorfor illumination level. 2.5.4. Luminous flux required for various purposes 2.5.5. Selection of lamps for various uses. 2.5.6 Methods of lighting calculation • Watts per square meter method • Lumen or light flux method • Inverse square law method	

		2.5.7. Perform calculation and layout of simple lighting scheme. 2.5.8. Calculation of power consumed, selection of wire and fuse, ratings, use of various types of fixtures for lighting purpose. 2.5.9 Numerical problem andsimple layout design related to the illumination design	
3	Industrial Utilization of Electrical Energy	3.1. Role of electrical energy in modern industry 3.2 Function of drives. 3.3 Different types of drives such as: • Individual, • Group and • Combination 3.4. Selection of various types of drives 3.5. Methods of motors selection-factors to be considered and electrical characteristics • According to load speed • According to load torque (starting and running torque) 3.6. Various types of motors for particular service sewing machines vacuum cleaner mixers hair dryers washing machines cranes printing machines grinding machines lifts drilling machines refrigeration air-conditioning metal industry	9

4	Traction System	4.1. Concept of Traction. 4.2. Various system of Traction. 4.3. Advantages and disadvantages of Traction. 4.4. Types of electrical vehicles fed from a separate system such as DC and AC supply system 4.5 Differentiate AC over DC supply system. 4.6. Drive of tramways, trolley buses, electric trains. 4.7. Braking of traction motor • Rheostatic braking • Regenerative braking	9
5	Power factor	5.1. Concept of power factor. 5.2. Causes of low power factor. 5.3. Effect of low power factor. 5.4. Advantages of power factor correction. 5.5.. Methods of improving power factor	8
6	Tariff	6.1. Introduction to tariff 6.2. Main objectives of tariff. 6.3. Calculating methods of tariff. 6.4. Types and application of tariff. 6.5. Tariff system in Nepal	6
	Total		64

5. Suggested Practical and Project Works

The practical and project works are integral parts of reinforcing the students' learning. So the new curriculum provisions the practical and projects works as a part of curriculum. Some of the sample practical and project works are suggested herewith. However, a teacher can adapt them or use similar other project works as per their students need and specific context.

S.N.	Grade 10		
	Content Area	**Some Suggested Practical Activities**	**Hrs.**
1	Introduction	▪ Prepare a report on application of energy for different sectors.	5
2	Illumination	• Calculation and layout design of lighting scheme of residential buildings. • Identification of types of luminaries • Measurement of illumination of various lamps using lux meter. • Observe the construction and connection of different lamps. Observation of different types of lighting schemes.	24
3	Industrial tilization of Electrical Energy	• Observation of drives used in different working areas • Identification of motor for particular purpose • Site visit of nearest industry	10
4	Traction System	• Observation of traction system	10
5	Power factor	• Showing leading and lagging power factor using oscilloscope • Observation of pf improvement with capacitor connected in circuit. • Site visit of nearest commercial or industrial building to observe the common practices for power factor improvement.	10
6	**Tariff**	• Understand the tariff system of Nepal and calculation. • Perform a case study on existing tariff system for different areas residential, commercial and industrial etc.	5
	Total		**64**

6. Learning Facilitation Process

This course intends to provide both theoretical as well as practical knowledge and skills on the subject, thereby, blends with both theoretical and practical facilitation strategies to ensure better learning. In fulfilling the learning outcomes stated in the curriculum, the teacher should use a variety of methods and techniques that fit to the contents. In particular, the following methods, techniques and strategies are used for learning facilitation:

- Demonstration
- Questionnaire
- Practical Works / Project works
- Audio/Visual use from different sources
- Problem Solving
- Exploration/Field Visit
- Discussion
- Group works and pair works

7. Student Evaluation

Evaluation is an integral part of learning process. Both formative and summative modes of evaluation are emphasized. Formative evaluation will be conducted so as to provide regular feedback for students, teachers and parents/guardians about how student learning is. Class tests, unit tests, oral question-answer, home assignment etc, are some ways of formative evaluation.

There will be separate evaluation of theoretical and practical learning. Summative evaluation embraces theoretical examination, practical examination and evaluation of research work or innovative work.

(a) Internal Evaluation

Internal evaluation covers 50 Percent weight age. Internal evaluation consists of Practical Activities (Practical works and projects works) (35 Percent), (b) Marks from trimester examinations (10 Percent), and (c) Classroom participation (5 Percent). Practical work should be based on list of activities mentioned in this curriculum. Project works should be based on the mentioned lists or created by teachers. Mark distribution

for internal evaluation (practical work and project work) will be as follows:

S.N.	Mani activities	Activities in detail	Percent
1	Participation	Participation in attendance, homework, classwork, project work, practical works etc.	5
2	Practical work	Conduction of practical work activities	15
		Record keeping of practical work activities	3
3	Project work	Conduction of project work activities	10
		Record keeping of project work activities	2
4	Viva	Viva of practical work and project work activities	5
6	Internal exam	First trimester 5 marks and Second trimester 5 marks	10
Total			50

Note:

(i) Practical examination will be conducted in the presence of internal and external supervisors. Evaluation of experiment will focus both the product of work and skills competencies of student in using apparatus.

(ii) Project work assessment is the internal assessment of reports and presentation of their project works either individually or group basis. In case of group presentation, every member of the group should submit a short reflection on the presented report in their own language. Records of project works must be attested by external supervisor.

(b) External Evaluation

Theoretical evaluation covers 50% of the weight. The tool for external evaluation of theoretical learning will be a written examination. Questions for the external examination will be based on the specification grid developed by Curriculum Development Centre. Examination question paper will be developed using various levels of revised Bloom's taxonomy including remembering level, understanding level, application level and higher ability (analyzing, evaluating, creating).

Specification Grid

Grade: 9 Subjects : Utilization of Electrical Energy Time : 2 hrs.

Unit	Content	Credit hrs.	Knowledge and Understand			Application			Higher Ability			Total Question Number			Total Question	Marks Weight			Total Marks
			MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long		MCQ	Short	Long	
1	Introduction to electrical energy	4	6	2	0	3	3	1	0	0	1	9	5	2	16	9	25	16	2
2	Illumination	28																	24
3	Industrial Utilization of Electrical Energy	9																	7
4	Traction System	9																	7
5	Power factor	8																	6
6	Tariff	6																	4
	Total	64	6	2	0	3	3	1	0	0	1	9	5	2	16	9	25	16	50