

# **CURRICULUM**

## **Pre-diploma in Railway Engineering**



**Council for Technical Education and Vocational Training  
Curriculum Development and Equivalence Division  
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## **Introduction**

The rail transport is an important means of transport all over the world. Railway engineering is a multi-faceted engineering discipline amalgamating with the design, construction and operation of all types of rail transport systems. It encompasses a wide range of engineering disciplines, including civil engineering, computer engineering, electrical engineering, mechanical engineering, industrial engineering, production engineering and a great many other engineering sub-disciplines are also called upon. Railway systems entail much more than a train and a track. They are based on advanced technical and operational solutions, dealing with continuously changing demands for more efficient transport for both passengers and freight every day. Each system consists of many components that must be properly integrated: from trains, tracks, stations, signaling and control systems, through proper implementation of repair and maintenance practices and its monitoring and the impact on cities, landscape and people. Railway is widely viewed as a vital component of the integrated transportation system for sustainable societies now as well as in the future.

Nepal Government has been planning to develop railway network in Nepal and connect with neighboring countries with railway network since 2010 AD. Few Indo-Nepal Cross-Border railway lines like Jayanagar – Janakpur-Bardibas, Jogbani - Biratnagar have been developed with technical and financial assistance from the Government of India and Mechi - Mahakali Railway line is under Design and construction phase. To run the train service on the railway line developed so far and on the railway lines to be developed in near future, field level technical workforce is required. The pre-diploma curriculum of Railway Engineering is designed to produce competent workforce equipped with knowledge, skills and attitudes related to the field of Railway engineering. The knowledge and skills incorporated in this curriculum will be helpful to deliver the national needs in the field of Railway Engineering.

## **Curriculum title**

The title of this curricular program is **Pre-diploma in Railway Engineering (PRE)**.

## **Program aim**

The aim of the program is to prepare middle level competent human resource Railway Engineering Technicians as **Assistant Sub-engineers** in equipped with knowledge and skills in railway engineering and allied subjects.

## **Program objectives**

This curriculum has following objectives to:

1. Provide services as a middle level technician in the field of design and development including field survey, drawing and construction supervision of various components of the railroad system and infrastructures through public and private organizations;
2. Perform operation, control, troubleshooting and repair, and maintenance of elements of the railway system;
3. Deserve technical know-how competencies about railway system and its complexities;
4. Assume an increasing level of roles and responsibilities within their respective organizations;

5. Communicate effectively and work collaboratively in multidisciplinary and multicultural work environments through recognizing and understanding global, environmental, social, and ethical contexts of their works.
6. Help in meeting the demand of required railway engineering technicians for railway network of Nepal; and
7. Enable to prepare business plan for establishing small scale production and service related construction industries and firms.

### **Program Description**

This curricular program is based on the job require to be performed by the middle level railways technician as **Assistant Sub-Engineers** at different levels of public and private organizations through involving in designing, construction and operation of all types of rail transport systems. This program includes various courses of railway engineering discipline including core courses of railway engineering such as Basic Railway Technology, Railway Track Technology, Railway EST (Electronics, Signaling and Telecommunication), Locomotive and Rolling Stocks, Railway Electrification, Estimation, Costing and Supervision, Engineering Drawing and Engineering Surveying.

Additionally, Computer Application and CAD, Entrepreneurship Development and Workshop Practice subjects are also offered here. The expected students will learn skills and knowledge in institutes and experience the world of work from work place learning through On-the-job training in related railway construction/operation companies.

### **Program Duration**

This course will be completed within 1.5 year/18 months (15 months in-house plus 3-month OJT). First 3 month consists of 9 Academic weeks/ 360 hours and one year consists of 35 academic weeks/1400 hours. Hence, the duration of in-house part is 44 academic weeks/1760 hours. In addition, 3 months/ 12 weeks/480 hours on-the-job assignment should also be completed for issuing successful completion of the course. The total duration of 2240 hours is allotted for this curricular program after the enrolment in a formal setting

### **Focus of Curriculum**

This is a competency-based curriculum. This curriculum emphasizes on competencies performance. Here 80% curricular time weightage is allotted for performance and remaining 20% time is allotted for related technical knowledge. Therefore, the focus will be on performance of the specified competencies in this curriculum.

### **Target Location**

The target location will be all over Nepal.

### **Group Size**

The group size of this program will be a maximum of 40 (forty) in a batch.

### **Target Group**

The target group for this program will be all interested individuals who have passed School Education Examinations (SEE) or equivalent to SEE pass.

## **Entry Qualification**

- SEE pass in any grade and any GPA obtained or equivalent or as per provisions mentioned in the admission guidelines of Office of the Controller of Examinations, CTEVT.
- Should pass entrance examination as administered by CTEVT

## **Medium of Instruction**

The medium of instruction will be in English and/or Nepali language.

## **Pattern of Attendance**

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

## **Teacher and Students Ratio**

- Overall ratio of teacher and student must be 1:10 (at the institution level)
- Teacher and student's ratio for theory class should be 1:40.
- Teacher and student's ratio for practical should be 1:10.

## **Qualification of Instructional Staff**

- Instructors should be Bachelor Degree holder in Railway Engineering or equivalent
- Assistant Instructors should be Diploma in Railway and Civil Engineering or equivalent
- Teaching Aide should be Pre-diploma holder in Railway Engineering or equivalent
- Good communication and instructional skills
- Experience in the related field

## **Instructional Media and Materials**

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

- **Printed Media Materials** (Assignment sheets, Handouts, Information sheets, Individual training packets, Procedure sheets, Performance Check lists, Textbooks etc.).
- **Non-projected Media Materials** (Display, Photographs, Flip chart, Poster, Writing board etc.).
- **Projected Media Materials** (Multimedia, Overhead transparencies, Slides etc.).
- **Audio-Visual Materials** (Audiotapes, Films, Slide-tape programs, Videodiscs, Videotapes etc.).
- **Computer-Based Instructional Materials** (Computer-based training, Interactive video etc.)
- **Web-Based Instructional Materials** (Online learning)
- **Radio/Television/Telephone**
- **Education-focused social media platforms**

## Teaching Learning Methodologies

The methods of teachings for this curricular program will be a combination of several approaches such as; Illustrated Lecture, Panel Discussion, Demonstration, Simulation, Group work, Guided practice, Practical experiences, Fieldwork, OJT, Report writing, Term paper presentation, Case analysis, Tutoring/coaching, Role-playing, Assignment, Heuristic, Project work and other Independent learning.

- Theory: Illustrated lecture Discussion, Seminar, Interaction, Assignment and Group work.
- Practical: Demonstration, Observation, Guided practice, Self-practice and Project work.
- OJT: Workplace-based learning at the railway design, construction/development and operation related institutions under the supervision of supervisor of OJT providing institutions.

## Approach of learning

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

## Examinations and Marking Scheme

- The distribution of marks for theory and practical tests will be as per the marks given in the curriculum structure of this curriculum for each subject. Ratio of internal and final evaluation is as follows:

S.N.	Particulars	Internal Assessment	Final Exam	Pass %
1	Theory	50%	50%	40%
2	Practical	50%	50%	60%
3	OJT			60%

- There will be three internal assessments to be administered by the institute and one final examination in each subject at the end of program. Moreover, the mode of internal assessment and final examination include both theory and practical or as per the nature of instruction as mentioned in the curriculum structure.
- Continuous evaluation of the students' performance is to be done by the related instructor/ trainer to ensure the proficiency over each competency under each area of a subject specified in the curriculum.
- The on-the-job training is evaluated in 300 full marks. The evaluation of the performance of the student is to be carried out by the three agencies; the concerned institute, OJT provider organization and the CTEVT Office of the Controller of Examinations. The student has to score minimum 60% marks for successful completion of the OJT.
- The students must secure minimum of 40% marks in theory and 60% marks in practical both in internal and final examinations. Additionally, the students must secure minimum of 60% marks in OJT for successful completion.

## Provision of Back Paper

There will be the provision of back paper but the students must pass all the subjects within

three years from the enrollment date; however, there should be a provision of chance exam for the students as per CTEVT rules.

### **Disciplinary and Ethical Requirements**

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

### **Grading System**

The grading system will be as follows:

<u>Grading</u>	<u>Overall marks</u>
Distinction	80% or above
First division	75% to below 80%
Second division	65% to below 75%
Third division	Pass aggregate to below 65%

### **Curriculum and Credits**

In this curriculum, each subject has its full marks and instructional hours; and instructional hours are divided into theory hours, practical hours and On-Job-Training hours (Practical)

### **Certificate Requirements**

The Council for Technical Education and Vocational Training, Office of the Controller of Examinations will award certificate of **Pre-diploma in Railway Engineering** to those students who gain a minimum mark of **60% in practical exam** and **40% in theoretical exam** in all subjects.

In addition, OJT has to be evaluated by keeping 300 as full marks. The evaluation of the performance of the students is to be carried out by the concerned railways Design/Construction/operation organization/company **where the student is placed and the CTEVT** unless otherwise directed by Office of the Controller of Examinations of the Council for Technical Education and Vocational Training. Here also the student has to score 60 % or above for successful completion of the curricular program.

### **Career Path**

The graduates will be eligible to work in the position of **Assistant Sub-engineer (Railway)** in the government related organizations as prescribed by the Public Service Commission or other concerned agencies.



## **General Attitudes Required**

An apprentice should demonstrate following general attitudes for effective and active learning.

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

**Curriculum Structure**  
**Pre-Diploma in Railway Engineering**

Teaching Scheme							Examination Scheme						Total Marks	Remarks
S. N	Subjects	Nature	Weekly Hours	Class Hours			Theory			Practical				
				T	P	Total	Assmt. Marks	Final		Assmt. Marks	Final			
								Marks	Time (Hrs.)		Marks	Time (Hrs.)		
<b>Section A: 3 months (9 Academic weeks@40 Hours per week) institute based</b>														
1.	Workshop Practice	P		20	62	82	-	-	-	25	25	3	50	
2.	Engineering Drawing	P		30	170	200	-	-	-	50	50	3	100	
3.	Entrepreneurship Development	T+P		30	48	78	10	10	2	15	15	3	50	
<b>Section B: 1 Year/12 months (35 Academic weeks@40 Hours per week) institute based</b>														
4.	Engineering Surveying	T+P	6	40	170	210	15	15	2	60	60	3	150	
5.	Basic Railway Technology	T+P	4	30	110	140	10	10	2	40	40	3	100	
6.	Railway Track Technology	T+P	4	30	110	140	10	10	2	40	40	3	100	
7.	Estimating Costing and Supervision	T+P	6	40	170	210	15	15	2	60	60	3	150	
8.	Railway EST (Electronics, Signaling and Tracking)	T+P	6	40	170	210	15	15	2	60	60	3	150	
9.	Locomotive and Rolling Stocks	T+P	4	30	110	140	10	10	2	40	40	3	100	
10.	Railway Electrification	T+P	6	40	170	210	15	15	2	60	60	3	150	
11.	Computer Application and Computer Aided Drafting	T+P	4	30	110	140	10	10	2	40	40	3	100	
<b>Subtotal</b>			<b>40</b>	<b>370</b>	<b>1390</b>	<b>1760</b>	<b>110</b>	<b>110</b>		<b>490</b>	<b>490</b>		<b>1200</b>	
<b>Section C: 3 months (12 Non-academic weeks@40 Hours per week)</b>														
12	On the Job Training (3Months)	P	40	-	480	480	-				300		300	
<b>Total</b>				<b>370</b>	<b>1870</b>	<b>2240</b>	<b>110</b>	<b>110</b>		<b>490</b>	<b>790</b>		<b>1500</b>	

**T= Theory and P= Practical.**

# Engineering Drawing

**Total:** 200 hours  
**Theory:** 30 hours  
**Practical:** 170 hours

## Course Description

This course is designed to impart basic knowledge and skills of drawings. It especially provides skills on Fundamentals of drawing along with handling tools for preparing drawings, drawing free hand sketches, different technical drawings, coping of drawings and some basics of railway drawings.

## Course Objectives

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

1. Explain scope and significance of engineering drawing;
2. Identify various drawing tools and instruments;
3. Apply lettering and dimensioning techniques;
4. Describe the scale, its type and construction;
5. Draw various geometrical figures;
6. Draw the different oblique and orthographic projections;
7. Draw simple residential, non-residential buildings, and railway drawings and;
8. Read and interpret various building and railways drawings;

## Module I: Basic Drawings

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
1.	Handle basic drawing tools/ instruments.	<b><u>Drawing tools and instruments:</u></b> <ul style="list-style-type: none"> <li>▪ Definition, importance and use of drawing</li> <li>▪ Tools &amp; instruments use in drawing</li> <li>▪ Handling techniques of drawing tools and instruments</li> </ul>	1	3	4
2.	Prepare drawing sheet with title block.	<b><u>Drawing sheet with title block:</u></b> <ul style="list-style-type: none"> <li>▪ Drawing sheets and their standard sizes</li> <li>▪ Annotation (letter size, types, measuring units)</li> <li>▪ Border lines and title blocks</li> </ul>	1	2	3
3.	Fold Drawing Sheets	<b><u>Folding of drawing sheet:</u></b> <ul style="list-style-type: none"> <li>▪ Importance of proper folding</li> <li>▪ Folding different types of Drawing Sheets</li> </ul>	1	2	3
4.	Draw free hand sketches.	<b><u>Sketch &amp; sketching techniques of different figures:</u></b> <ul style="list-style-type: none"> <li>▪ Different figures                             <ul style="list-style-type: none"> <li>• Straight lines (horizontal, vertical and inclined)</li> <li>• Circles</li> </ul> </li> </ul>	1	3	4

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
		<ul style="list-style-type: none"> <li>• Arcs &amp; curves</li> <li>▪ Uses of freehand sketches</li> <li>▪ Difference between drawing &amp; sketch</li> </ul>			
5.	Apply different scales.	<p><b><u>Drawing scale:</u></b></p> <ul style="list-style-type: none"> <li>▪ Types of scales; Plain and diagonal, Reducing and Enlarging scale &amp; vice-versa</li> <li>▪ Representative Fraction</li> <li>▪ Different types of measuring systems and its conversions</li> </ul>	1	3	4
6.	Draw different types of lines.	<p><b><u>Drawing lines:</u></b></p> <ul style="list-style-type: none"> <li>▪ Different types of lines and symbols: Outlines, Dashed lines, Center line, dimension line, extension line, hatching/section line, Leader/Pointer lines, Cutting-Plane lines, Boarder line, Long and short break line and their uses</li> <li>▪ Line thickness</li> </ul>	1	2	3.0
7.	Write English letter/ numbering script.	<p><b><u>Letter and numbering script:</u></b></p> <ul style="list-style-type: none"> <li>▪ Different lettering; Single-stroke letters &amp; their writing rules</li> <li>▪ Essential features of lettering</li> </ul>	0.5	2	2.5
8.	Construct different regular geometrical figures (rectangle/ square/ triangles/ parallelogram/rhombus/ circle).	<p><b><u>Regular geometrical figures:</u></b></p> <ul style="list-style-type: none"> <li>▪ Angle &amp; their types</li> <li>▪ Triangle &amp; their types</li> <li>▪ Quadrilaterals &amp; their types</li> </ul>	0.5	6	6.5
9	Construct regular polygons. (Pentagon/Hexagon/Heptagon /Octagon)	<p><b><u>Regular polygons:</u></b></p> <ul style="list-style-type: none"> <li>▪ Regular polygon &amp; their types.</li> <li>▪ Construction methods</li> </ul>	1	4	5
10.	Bisect a straight line	<p><b><u>Bisection of straight lines:</u></b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Procedure of bisection</li> </ul>	2	10	12
11.	Divide a straight line into equal parts.	<p><b><u>Straight lines division:</u></b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Procedure of division of straight line into equal parts</li> </ul>			
12.	Bisect / divide an angle.	<p><b><u>Bisection of angle:</u></b></p> <ul style="list-style-type: none"> <li>▪ Angles &amp; their types</li> <li>▪ Procedure of bisection of an angle</li> </ul>			
13.	Bisect circular arc.	<p><b><u>Bisection of circular arc:</u></b></p> <ul style="list-style-type: none"> <li>▪ Different engineering curves</li> </ul>			

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
		<ul style="list-style-type: none"> <li>▪ Procedure of bisection of circular arc</li> </ul>			
14.	Locate the center point of a circular arc.	<u><b>Location of center point:</b></u> <ul style="list-style-type: none"> <li>▪ Procedure of locating center point of a circular arc</li> </ul>			
15.	Draw a parabola.	<u><b>Parabola:</b></u> <ul style="list-style-type: none"> <li>▪ Construction procedure of parabola</li> <li>▪ Tangent, rectangle, offset method</li> </ul>	1	3	4
16.	Draw an ellipse.	<u><b>Ellipse:</b></u> <ul style="list-style-type: none"> <li>▪ Concept of conic sections</li> <li>▪ Concentric circle &amp; Arc of circle methods</li> </ul>	1	3	3.5
17.	Dimension the drawing.	<u><b>Dimensioning:</b></u> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Dimension types</li> <li>▪ Procedure for dimensioning</li> </ul>	1	2	3
18.	Draw orthographic projection of simple objects. (I & III angles projection)	<u><b>Orthographic projection</b></u> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Projection &amp; their types</li> <li>▪ Methods of orthographic projection (I &amp; III angle projection)</li> <li>▪ Glass box (Projection box)</li> </ul>	2	6	8
19.	Draw isometric views.	<u><b>Isometric projection:</b></u> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Isometric scale</li> <li>▪ Process of preparation of isometric drawing</li> <li>▪ Free hand sketch of isometric views</li> </ul>	2	6	8
20.	Draw sections.	<u><b>Sectioning:</b></u> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Cutting plane or section plane</li> <li>▪ True shape of a section</li> <li>▪ Section lines</li> </ul>	1	3	4
<b>Sub-total I</b>			<b>18</b>	<b>60</b>	<b>78</b>

### Module II: Engineering Drawings

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
21.	Prepare site plan.	<u><b>Site plan:</b></u> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Necessity</li> <li>▪ Elements to be shown in the site plan</li> </ul>	0.5	2	2.5

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
		<ul style="list-style-type: none"> <li>▪ Scale &amp; orientation of site plan</li> <li>▪ Composition of drawing</li> </ul>			
22.	Prepare location plan.	<u><b>Location plan:</b></u> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Necessity</li> <li>▪ Technique of showing north direction</li> <li>▪ Showing road &amp; other important features</li> <li>▪ Use of symbols</li> </ul>	0.5	2	2.5
23.	Draw General Arrangement Drawing (GAD).	<u><b>GAD of building:</b></u> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Building GAD</li> </ul>	0.5	2	2.5
24.	Draw Index Plan/ Index Section.	<u><b>Index plan and index section:</b></u> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Index Plan</li> <li>▪ Index Section</li> </ul>	0.5	2	2.5
<b>Sub-total II</b>			<b>2</b>	<b>8</b>	<b>10</b>
<b>Total (Sub-total I +Sub-total II)</b>			<b>20</b>	<b>68</b>	<b>88</b>

### Module III: Detail Drawings

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
25.	Draw section of simple building (Single storied two roomed building).	<u><b>Sections of building:</b></u> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Section plan in building plan</li> <li>▪ G.L., P.L., D.P.C. Sill level, lintel level, walls, roof, &amp; its type roof covering</li> <li>▪ Symbols used for wall, concrete, timber, glass, sections</li> </ul>	2	6	8
26.	Draw steel-bar diagram/ schedule.	<u><b>Steel bar diagram:</b></u> <ul style="list-style-type: none"> <li>▪ Important of bar bending schedule</li> <li>▪ Thumb rule for calculation of steel bars</li> <li>▪ Spacing &amp; diameter of steel bars</li> <li>▪ Process of preparation of bar bending diagram</li> </ul>	1	4	5
27.	Draw typical section of RCC bridge	<u><b>Bridge Drawing:</b></u> <ul style="list-style-type: none"> <li>▪ Types of Bridges</li> <li>▪ Well Foundation Bridge</li> <li>▪ Pile Foundation Bridge</li> </ul>	0.5	4	4.5
28.	Draw section of RCC Culvert	<u><b>Culvert drawing:</b></u>	0.5	3	3.5

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
		<ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Functions/Location</li> <li>▪ Typical Section</li> </ul>			
29.	Draw section of foot over bridge (FOB)	<b><u>FOB drawing:</u></b> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Functions/Location</li> <li>▪ Typical Section</li> </ul>	0.5	3	3.5
30.	Draw Weld/Rivet Joints	<b><u>Welding drawing:</u></b> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Functions/Location</li> <li>▪ Symbols</li> </ul> <b><u>Rivet drawing:</u></b> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Functions/Location</li> <li>▪ Symbols</li> </ul>	1	4	5
31.	Draw plan/ elevation/ section/ location plan/ site plan of Railway Station building.	<b><u>Building design:</u></b> <ul style="list-style-type: none"> <li>▪ Concept of design</li> <li>▪ Design criteria</li> </ul>	0.5	12	12.5
		<b>Sub-total III</b>	<b>6</b>	<b>36</b>	<b>42</b>
	<b>Total (Sub-total I +Sub-total II+ Sub-total III)</b>		<b>26</b>	<b>104</b>	<b>130</b>

#### Module IV: Railway Drawings

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
32.	Draw plan/ elevation/ section/ location plan/ site plan of Typical Station Yard.	<b><u>Station Yard:</u></b> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Components <ul style="list-style-type: none"> <li>• Different lines</li> <li>• Platforms</li> <li>• Signals</li> <li>• Turnouts</li> <li>• Cross overs</li> </ul> </li> <li>▪ Station Yards <ul style="list-style-type: none"> <li>• Block Station</li> <li>• Junction Station</li> <li>• Terminal Station</li> <li>• Goods Station</li> </ul> </li> </ul>	2	32	34
33.	Draw Typical cross section of Railway Track.	<b><u>Railway track:</u></b> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Components <ul style="list-style-type: none"> <li>• Sub Base</li> <li>• Base</li> <li>• Ballast</li> <li>• Sleepers</li> <li>• Rail</li> <li>• Rail Clips</li> </ul> </li> </ul>	1	10	11
34.	Draw section of I - beam Rail	<b><u>I-Beam rail:</u></b>	0.5	12	12.5

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
		<ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Design Criteria</li> </ul>			
35.	Draw section of Sleepers	<u>Sleeper drawing:</u> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Functions/Location</li> <li>▪ Typical Section</li> </ul>	0.5	12	12.5
		<b>Sub-total II</b>	<b>4</b>	<b>66</b>	<b>70</b>
<b>Total (Sub-total I +Sub-total II+ Sub-total III+ Subtotal IV)</b>			<b>30</b>	<b>170</b>	<b>200</b>

### Textbooks

- Civil Engineering Drawing; Gurcharan Singh, Standard Publishers distributors

### References

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- Luzzadar W. I Fundamental of Engineering drawing. Prentice-Hall of India.
- N. D. Bhatta and Panchal V.M. Engineering Drawing Charotar Publishing House India.
- M. B. Shah and B.C. Rana, Engineering Drawing, Pearson India.



## Workshop Practice

**Total: 82 hours**  
**Theory: 20 hours**  
**Practical: 62 hours**

### Course Description

This course is designed to impart essential knowledge and skills used in Mechanical Workshops. It focuses on providing basic knowledge and skills on Workshop Safety, Hand Tools, Mechanical Fitting, Sawing, Drilling, Measuring Instruments & Gauges, Sheet Metal Works, Arc Welding, Lathe Machine Operation etc.

According to the nature and volume of the practical tasks, the students can work individually or in groups.

### Course Objectives

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

1. Explain basic manufacturing processes and production technology used in workshops;
2. Follow workshop safety practices;
3. Handle tools, equipment, machines and materials used in workshop;
4. Perform various operations used in Mechanical Fitting, Sheet Metal Works, Welding and Lathe Shops; and
5. Make various metal items.

### Module I: Introduction to Workshop

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
1.	Be familiar with workshop.  Identify hand tools.	<b><u>Overview of workshop and hand tools:</u></b> <ul style="list-style-type: none"> <li>▪ Introduction of workshop</li> <li>▪ Function of workshop</li> <li>▪ Introduction of hand tools</li> <li>▪ Application of hand tools</li> <li>▪ Handling and care</li> </ul>	1	0.5	1.5
2.	Follow workshop/workplace safety rules: <ul style="list-style-type: none"> <li>• Use personal protective equipment (PPE).</li> <li>• Apply workshop safety measures.</li> <li>• Apply tools/equipment safety measures.</li> <li>• Enforce electrical safety measures.</li> <li>• Apply health hazards safety measures.</li> <li>• Apply simple first aid treatment procedure.</li> </ul>	<b><u>Workshop safety:</u></b> <ul style="list-style-type: none"> <li>▪ Definition of safety</li> <li>▪ Importance of safety</li> <li>▪ Concept of occupational health and safety</li> <li>▪ Different signs and symbols of safety</li> <li>▪ Common safety rules used in workshop</li> <li>▪ Need of Personal Protective Equipment (PPE)               <ul style="list-style-type: none"> <li>• Safety helmet</li> <li>• Clear or colored goggles</li> <li>• Protective gloves or gauntlets</li> <li>• Foot wear an appropriate type</li> </ul> </li> </ul>	1.5	4	5.5

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
		<ul style="list-style-type: none"> <li>• Respiratory protective equipment</li> <li>• Safety harnesses</li> <li>• Life vests</li> <li>• Life preservers</li> <li>• Reflective devices</li> <li>▪ Workplace safety measures</li> <li>▪ Tools/equipment safety measures.</li> <li>▪ Electrical hazards safety measures.</li> <li>▪ Simple first aid treatment procedure for: <ul style="list-style-type: none"> <li>• Bleeding</li> <li>• Burns</li> <li>• Fractures</li> <li>• Sprains</li> <li>• Nose bleeds</li> <li>• Fort bite</li> <li>• Bee stings</li> <li>• Snake bite</li> <li>▪ First aid kit includes: <ul style="list-style-type: none"> <li>• Bandages, roller bandages and tape</li> <li>• Sterile gauze</li> <li>• Antiseptic wipes and swabs</li> <li>• Absorbent compresses</li> <li>• Antibiotic cream</li> <li>• Burn ointment</li> <li>• Mask for breathing (rescue breathing/CPR)</li> <li>• Chemical cold pack</li> <li>• Eye shield and eyewash</li> <li>• First aid reference guide that includes local phone number</li> </ul> </li> </ul> </li> <li>▪ First aid procedure</li> </ul>			
		<b>Sub-total I</b>	<b>2.5</b>	<b>4.5</b>	<b>7</b>

### Module II: Basic Hand Tools Operation

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
3.	Perform Filling	<u><b>Filling:</b></u> <ul style="list-style-type: none"> <li>▪ Introduction <ul style="list-style-type: none"> <li>• Material of work piece</li> </ul> </li> </ul>	0.5	2	2.5

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
		<ul style="list-style-type: none"> <li>• Bench vice</li> <li>▪ Filing Tools</li> <li>• Introduction</li> <li>• Types</li> <li>• Function</li> <li>• Identification</li> <li>▪ Measuring and marking Tools (steel ruler, marking scribe, try square)</li> <li>▪ Procedure</li> <li>▪ Safety precautions</li> </ul>			
4.	Perform Sawing/Saw Metal Piece by Hand Hacksaw	<p><b><u>Sawing:</u></b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Hand hacksaw types/parts</li> <li>▪ Hand hacksaw blades</li> <li>▪ Procedure</li> </ul> <p>Safety precautions</p>	0.5	2	2.5
5.	Perform Drilling	<p><b><u>Drilling:</u></b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Types, Parts (Bench drill, Hand drill and Pedestal drill)</li> <li>▪ Drill bit</li> <li>▪ Procedure</li> </ul> <p>Safety precautions</p>	0.5	2	2.5
6.	Handle Measuring Instruments <ul style="list-style-type: none"> <li>• Measure dimension using steel ruler</li> <li>• Measure dimension using bevel protector</li> <li>• Check square using try square</li> </ul> Measure dimension using Vernier calipers	<p><b><u>Handling measuring instruments:</u></b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Types/parts</li> <li>▪ Importance and uses</li> <li>▪ Procedure of handling measuring instrument (steel ruler, bevel protector, try square and Vernier calipers)</li> </ul>	0.5	2	2.5
<b>Sub-total II</b>			<b>2</b>	<b>8</b>	<b>10</b>

### Module III: Sheet Metal Works

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
6.	Identify/ measure sheet metals	<p><b><u>Introduction:</u></b></p> <ul style="list-style-type: none"> <li>▪ Sheet metal related hand tools and materials</li> <li>▪ Safety precautions</li> </ul>	0.5	0.5	1
7.	Cut metal sheet in straight and curve shape by snip	<p><b><u>Snipping:</u></b></p> <ul style="list-style-type: none"> <li>▪ Tools and materials</li> <li>▪ Straight snip</li> <li>▪ Curve snip</li> </ul>	0.5	1.5	2

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
		<ul style="list-style-type: none"> <li>▪ Application</li> <li>▪ Procedure</li> <li>▪ Safety precautions</li> </ul>			
8.	Fold metal sheet by hand Tools	<u><b>Hand tools:</b></u> <ul style="list-style-type: none"> <li>▪ Tools and materials</li> <li>▪ Mallet</li> <li>▪ Stack</li> <li>▪ Folding procedure</li> <li>▪ Safety precautions</li> </ul>	0.5	2	2.5
9.	Fold metal sheet by folding machine	<u><b>Folding machine:</b></u> <ul style="list-style-type: none"> <li>▪ Tools and materials</li> <li>▪ Folding machine</li> <li>▪ Procedure</li> <li>▪ Safety precautions</li> </ul>	0.5	2	2.5
10.	Make seam joint	<u><b>Seam joint:</b></u> <ul style="list-style-type: none"> <li>▪ Types of seam joint</li> <li>▪ Tools/equipment</li> <li>▪ Margin calculation</li> <li>▪ Procedure</li> <li>▪ Safety precautions</li> </ul>	0.5	2	2.5
11.	Make rivet joint	<u><b>Seam joint:</b></u> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Rivets pin and its types</li> <li>▪ Tools and materials</li> <li>▪ Rivet hole calculation</li> <li>▪ Rivet punch</li> <li>▪ Procedure</li> <li>▪ Safety precautions</li> </ul>	0.5	2	2.5
		<b>Sub-total III</b>	<b>3</b>	<b>10</b>	<b>13</b>

#### Module IV: Welding

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
12.	Perform striking	<u><b>Striking:</b></u> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Types of welding machine</li> <li>▪ Tools &amp; equipment</li> <li>▪ Electrode</li> <li>▪ Set ampere</li> <li>▪ Arc</li> <li>▪ Material</li> <li>▪ Striking method</li> <li>▪ Safety precautions</li> </ul>	1	2	3
13.	Perform surface welding.	<u><b>Surface welding:</b></u> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Tools &amp; equipment</li> <li>▪ Electrode</li> </ul>	0.5	2	2.5

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
		<ul style="list-style-type: none"> <li>▪ Set ampere</li> <li>▪ Deposition</li> <li>▪ Procedure</li> <li>▪ Safety precautions</li> </ul>			
14.	Grind off welding surfaces	<p><b><u>Grinding process:</u></b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Types of grinding machine</li> <li>▪ Tools &amp; equipment</li> <li>▪ Material</li> <li>▪ Grinding process</li> <li>▪ Safety precautions</li> </ul>	0.5	2	3.5
15.	Perform arc welding: <ul style="list-style-type: none"> <li>• Lap joint</li> <li>• Butt Joint</li> <li>• Corner Joint</li> <li>• Tee (T) Joint</li> </ul>	<p><b><u>Arc welding:</u></b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Tools &amp; equipment</li> <li>▪ Electrode</li> <li>▪ Set ampere</li> <li>▪ Arc</li> <li>▪ Angle of electrode</li> <li>▪ Weaving and travel speed</li> <li>▪ Material</li> <li>▪ Deposition</li> <li>▪ Welding process</li> <li>▪ Safety precautions</li> </ul>	1	5	6
16.	Perform gas welding: <ul style="list-style-type: none"> <li>▪ Horizontal position</li> <li>▪ Vertical Position</li> <li>▪ Inclined position</li> <li>▪ Overhead position</li> </ul>	<p><b><u>Gas welding:</u></b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Different positions</li> <li>▪ Safety</li> <li>▪ Tools &amp; equipment</li> <li>▪ Filler Materials</li> <li>▪ Deposition</li> <li>▪ Welding process</li> <li>▪ Gas cutting process</li> <li>▪ Safety precautions</li> </ul>	1	4	5
		<b>Sub-total IV</b>	<b>4</b>	<b>15</b>	<b>19</b>

### Module V: Lathe Machine Operation

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
17.	Set work piece in three jaw Chuck / Four Jaw Chuck	<p><b><u>Three jaw chuck and four jaw chuck:</u></b></p> <ul style="list-style-type: none"> <li>▪ Introduction of lathe machine</li> <li>▪ Types</li> <li>▪ Parts and function</li> <li>▪ Introduction of chuck</li> <li>▪ Types of chuck</li> <li>▪ Principle of three and four</li> </ul>	1	1	2

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
		jaw chuck <ul style="list-style-type: none"> <li>▪ Construction three and four jaw chuck</li> <li>▪ Clamping in three and four jaw chuck</li> <li>▪ Procedure</li> <li>▪ Safety precautions</li> </ul>			
18.	Set work piece in collet chuck	<b><u>Collet chuck:</u></b> <ul style="list-style-type: none"> <li>▪ Introduction of collect chuck</li> <li>▪ Type of chuck</li> <li>▪ Principle of chuck</li> <li>▪ Clamping in collet chuck</li> <li>▪ Procedure</li> <li>▪ Safety precautions</li> </ul>	0.5	1	1.5
19.	Set turning tool on tool post	<b><u>Turning tools:</u></b> <ul style="list-style-type: none"> <li>▪ Introduction of Lathe tool</li> <li>▪ type of lathe tool</li> <li>▪ Tool geometry</li> <li>▪ Introduction of tool post</li> <li>▪ Types of tool post</li> <li>▪ Principle of tool setting</li> <li>▪ Effect of tool height</li> <li>▪ Procedure</li> <li>▪ Safety precautions</li> </ul>	0.5	1	1.5
20.	Set machine control.	<b><u>Machine control:</u></b> <ul style="list-style-type: none"> <li>▪ Selection of RPM</li> <li>▪ Selection of feed, depth of cut, number of cuts</li> <li>▪ Setting of gearbox.</li> <li>▪ Manual and automatic</li> <li>▪ Procedure</li> <li>▪ Safety precautions</li> </ul>	0.5	1	1.5
21.	Perform Turning/Facing/Center Drilling/ Drilling	<b><u>Turning, Facing, Center Drilling, Drilling:</u></b> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Process of Turning</li> <li>▪ Process of setting tailstock</li> <li>▪ In-center and out-center</li> <li>▪ Facing tool</li> <li>▪ Process of Facing</li> <li>▪ Center drill</li> <li>▪ Types of drill</li> <li>▪ Drill bit geometry</li> <li>▪ Sleeve and its types</li> <li>▪ Procedure</li> <li>▪ Safety precautions</li> </ul>	1	2	3

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
22.	Perform plain turning	<u><b>Plain turning:</b></u> <ul style="list-style-type: none"> <li>▪ Definition</li> <li>▪ Process</li> <li>▪ Types of operation</li> <li>▪ Manual and automatic</li> <li>▪ Procedure</li> <li>▪ Safety precautions</li> </ul>	0.5	2	2.5
23.	Perform step turning	<u><b>Step turning:</b></u> <ul style="list-style-type: none"> <li>▪ Definition</li> <li>▪ Process</li> <li>▪ Procedure</li> <li>▪ Safety precautions</li> </ul>	0.5	2	2.5
24.	Perform Chamfering	<u><b>Chamfering:</b></u> <ul style="list-style-type: none"> <li>▪ Definition</li> <li>▪ Process</li> <li>▪ Angle for chamfering</li> <li>▪ Chamfer tool/Form tool</li> <li>▪ Procedure</li> <li>▪ Safety precautions</li> </ul>	0.5	1	1.5
25.	Perform Knurling	<u><b>Knurling:</b></u> <ul style="list-style-type: none"> <li>▪ Definition</li> <li>▪ Process</li> <li>▪ Types of knurling tool</li> <li>▪ Procedure</li> <li>▪ Safety precautions</li> </ul>	0.5	1	1.5
26.	Perform boring	<u><b>Boring:</b></u> <ul style="list-style-type: none"> <li>▪ Definition</li> <li>▪ Process</li> <li>▪ Types of bore and its use</li> <li>▪ Introduction to boring tool</li> <li>▪ Procedure</li> <li>▪ Safety precautions</li> </ul>	0.5	1	1.5
27.	Perform parting off operation	<u><b>Parting off operation:</b></u> <ul style="list-style-type: none"> <li>▪ Definition</li> <li>▪ Types and its importance</li> <li>▪ Introduction of parting tool</li> <li>▪ Chattering control</li> <li>▪ Procedure</li> <li>▪ Safety precautions</li> </ul>	0.5	1.5	2
		<b>Sub-total V</b>	<b>6.5</b>	<b>14.5</b>	<b>21</b>

## Module VI: Project Work

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
28.	Make a Sheet Metal Dust Pan	<b><u>Dust pan:</u></b> <ul style="list-style-type: none"> <li>▪ Function</li> <li>▪ Interpretation of drawing</li> <li>▪ Procedure</li> <li>▪ Safety Precautions</li> </ul>	0.5	2.5	3
29.	Make hammer head.	<b><u>Hammer Head:</u></b> <ul style="list-style-type: none"> <li>▪ Interpretation of drawing</li> <li>▪ Procedure</li> <li>▪ Safety Precautions</li> </ul>	0.5	2.5	3
30.	Make Hammer handle.	<b><u>Hammer handle:</u></b> <ul style="list-style-type: none"> <li>▪ Interpretation of drawing</li> <li>▪ Procedure</li> <li>▪ Safety Precautions</li> </ul>	0.5	2.5	3
31.	Assemble/ Weld parts of Hammer	<b><u>Parts of hammer:</u></b> <ul style="list-style-type: none"> <li>▪ Parts and their names</li> <li>▪ Measurement</li> <li>▪ Procedure</li> <li>▪ Safety precautions</li> </ul>	0.5	2.5	3
		<b>Sub-total VI</b>	<b>2</b>	<b>10</b>	<b>12</b>
<b>Total (sub-total I+ sub-total II+ sub-total III+ sub-total IV+ sub-total V+ sub-total VI)</b>			<b>20</b>	<b>62</b>	<b>82</b>

## References

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# Engineering Surveying

**Total:** 210 hours  
**Theory:** 40 hours  
**Practical:** 170 hours

## Course Description

This course is designed to impart basic knowledge and skill in surveying techniques. It consists of fundamentals of surveying along with principle of surveying and handling of minor and major instruments for conducting various types of surveys and preparing necessary drawings/maps; details surveying such as chain surveying, compass traversing, leveling and theodolite traversing. It also deals with acquainting and handling the sophisticated surveying instruments such as total station and techniques as per the latest technological innovations.

## Course Objectives

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

1. Explain scope and important of surveying;
2. Identify various minor and major survey instruments;
3. Illustrate the basic principle of surveying;
4. Perform fundamental works of surveying;
5. Conduct different detailed surveying such as chain surveying, compass traversing, leveling and theodolite traversing;
6. Perform various survey data plotting works;
7. Conduct topographic survey for building and railways construction site; and
8. Perform setting out of horizontal curves and vertical curves.

## Module 1: Fundamentals of Surveying

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
1.	Acquaint the objectives of Surveying	<b><u>Concept of surveying:</u></b> <ul style="list-style-type: none"> <li>▪ Definition</li> <li>▪ History</li> <li>▪ Primary division of survey</li> <li>▪ Classification and types</li> <li>▪ Objective of surveying</li> </ul>	2		2
2.	Illustrate the basic principles of surveying.	<b><u>Principles of surveying:</u></b> <ul style="list-style-type: none"> <li>▪ Principles of surveying</li> </ul>	2		2
3.	Describe accuracy and errors.	<b><u>Accuracy and errors:</u></b> <ul style="list-style-type: none"> <li>▪ Definition of accuracy, precision and error</li> <li>▪ Types and sources of errors</li> </ul>	1		1
4.	Enlist units of measurement.	<b><u>Units of measurement:</u></b> <ul style="list-style-type: none"> <li>▪ Units of measurement</li> <li>▪ Unit conversion</li> </ul>	1	2	3
5.	Carry out scale conversion.	<b><u>Scale conversion</u></b> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Types of scale</li> <li>▪ Scale conversion</li> </ul>	1	2	3

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
6.	Measure distance using pacing factor.	<p><b><u>Distance measurement:</u></b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Determination of pacing factor</li> <li>▪ Measurement of distance using pacing factor</li> </ul>	1.0	2	3
7.	Handle minor survey instruments (using Measuring tape, Peg, Plumb bob, Ranging rods, Arrow, Level-pipe, and Optical Square).	<p><b><u>Survey instruments:</u></b></p> <ul style="list-style-type: none"> <li>▪ Basic survey instruments (Major and minor)</li> <li>▪ Function of survey instruments</li> <li>▪ Handling procedure</li> <li>▪ Safety precautions</li> </ul>	2.5	3.0	5.5
8.	Measure linear distance ((using Measuring Tape, Peg, Plumb bob, Ranging rods, Arrow, Level-pipe, and Optical Square).	<p><b><u>Linear measurements:</u></b></p> <ul style="list-style-type: none"> <li>▪ Horizontal distance</li> <li>▪ Methods of distance measurements (Direct and indirect only)</li> <li>▪ Tools and equipment used for measurement</li> <li>▪ Linear and angular measurement.</li> <li>▪ Measurement procedure in plain and sloped surface</li> <li>▪ Tape correction for absolute length</li> <li>▪ Direct and indirect ranging</li> </ul>	2.5	4.0	6.5
	Transfer level using Level pipe.	<p><b><u>Level transferring:</u></b></p> <ul style="list-style-type: none"> <li>▪ Definition</li> <li>▪ Plumb line</li> <li>▪ Level line</li> <li>▪ Selection of reference points</li> <li>▪ Multi step level transfer using Level-pipe</li> </ul>	2.0	7.0	8.0
9.	Set out simple building foundation with measuring tape and other instruments.	<p><b><u>Setting out:</u></b></p> <ul style="list-style-type: none"> <li>▪ Concept</li> <li>▪ Perpendicular offsetting by 3-4-5 method and Optical square</li> </ul>	1.5	5.0	6.5
10.	Conduct chain surveying using measuring tape and pegs/arrows	<p><b><u>Chain surveying:</u></b></p> <ul style="list-style-type: none"> <li>▪ Definition</li> <li>▪ Principles</li> <li>▪ Terminologies</li> <li>▪ Establishment of base line</li> <li>▪ Check line</li> <li>▪ Tie line</li> <li>▪ Offset and offset taking procedure</li> </ul>	2.0	10.0	12.0

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
		<ul style="list-style-type: none"> <li>▪ Obstacles in chaining (accessible)</li> <li>▪ Reference points</li> </ul>			
11.	Plot chain survey data.	<p><b><u>Chain survey data plotting:</u></b></p> <ul style="list-style-type: none"> <li>▪ Procedure</li> <li>▪ Scales in plotting</li> <li>▪ Plot chain survey data</li> <li>▪ Maps and legends</li> </ul>	1.5	5.0	6.5
12.	Calculate land area.	<p><b><u>Land measurements:</u></b></p> <ul style="list-style-type: none"> <li>▪ Division of land into Well-conditioned triangles (Triangulation)</li> <li>▪ Measure of all sides of triangles</li> <li>▪ Formula to calculate area of triangle when all sides known</li> <li>▪ Conversion of calculated land area to local system (Ropani-Aana-Paisa-Daam and Bigha-Katha-Dhur-Kanwa)</li> </ul>	1.0	6.0	7.0
13.	Set up/ handle compass.	<p><b><u>Compass setting and traversing:</u></b></p> <ul style="list-style-type: none"> <li>▪ Definition</li> <li>▪ Terminologies</li> <li>▪ Function</li> <li>▪ Types of compass</li> <li>▪ Setting and handling of compass</li> <li>▪ Compass traversing <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Technical terms (meridians, bearing and angles)</li> <li>• Systems of bearing (Fore and back bearing)</li> <li>• Prismatic and Surveyor's compass</li> </ul> </li> </ul>	1.5	4.0	5.5
14.	Set up/ handle plane table.	<p><b><u>Plane table setting up:</u></b></p> <ul style="list-style-type: none"> <li>▪ Definition</li> <li>▪ Terminologies</li> <li>▪ Principles</li> <li>▪ Functions</li> <li>▪ Instruments and accessories</li> <li>▪ Setting up</li> <li>▪ Methods of plane tabling</li> </ul>	2	5	7
15.	Perform plane table surveying. (Radiation and Intersection	<p><b><u>Plane tabling:</u></b></p> <ul style="list-style-type: none"> <li>▪ Working operations</li> </ul>	1	12	13

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
	methods)	<ul style="list-style-type: none"> <li>• Temporary adjustment</li> <li>• Orientation</li> <li>▪ Errors in plane table surveying</li> <li>▪ Merits and demerits of plane table surveying</li> <li>▪ Setting up plane table</li> <li>▪ Radiation method</li> <li>▪ Intersection method</li> <li>▪ Procedure</li> </ul>			
16.	Perform level surveying.	<p><b>Leveling:</b></p> <ul style="list-style-type: none"> <li>▪ Definition and terminologies</li> <li>▪ Objectives</li> <li>▪ Auto level</li> <li>▪ Staff</li> <li>▪ Datum line</li> <li>▪ Back sight, intermediate sight, foresight.</li> <li>▪ Line of collimation</li> <li>▪ Parallax elimination</li> <li>▪ Reduced Level (R.L.</li> <li>▪ Procedure in leveling</li> <li>▪ Types of leveling</li> <li>▪ Level book and entry procedure.</li> </ul>	4.0	17.0	21.0
<b>Sub-total I</b>			<b>28.5</b>	<b>84</b>	<b>112.5</b>

### Module II: Engineering Surveying

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
17.	Perform Two Peg Test.	<p><b>Two Peg Test:</b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Propose</li> <li>▪ Procedure</li> </ul>	0.5	2	2.5
18.	Calculate the level survey data.	<p><b>Level survey data:</b></p> <ul style="list-style-type: none"> <li>▪ Method of calculation (Rise &amp; fall method and HI method).</li> <li>▪ Arithmetic check and its application</li> </ul>	1	6.0	7
19.	Plot longitudinal profile.	<p><b>Longitudinal profile:</b></p> <ul style="list-style-type: none"> <li>▪ Definition and types</li> <li>▪ Procedure</li> <li>▪ Plotting scales</li> <li>▪ Plot longitudinal profile</li> </ul>	1	6.0	7
20.	Plot cross section profile.	<p><b>Cross section profile:</b></p> <ul style="list-style-type: none"> <li>▪ Definition</li> </ul>	1	6.0	7

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
		<ul style="list-style-type: none"> <li>▪ Procedure</li> <li>▪ Plotting scales</li> <li>▪ Plot cross section profile</li> </ul>			
21.	Perform contour surveying.	<p><b><u>Contouring:</u></b></p> <ul style="list-style-type: none"> <li>▪ Definition (contour, contour interval, contour index, horizontal equivalent, vertical equivalent)</li> <li>▪ Criteria for selection of contours</li> <li>▪ Characteristics of contours</li> <li>▪ Interpolation and its methods</li> <li>▪ Methods of contouring (direct and indirect)</li> <li>▪ Uses of contouring</li> </ul>	1.0	12.0	13.0
22.	Set out Theodolite over a given point.	<p><b><u>Theodolite setting up:</u></b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Functions</li> <li>▪ Set up (Orientation, Centering and Leveling)</li> </ul>	1.0	5.0	6.0
23.	Measure angles using Theodolite.	<p><b><u>Angle measurement:</u></b></p> <ul style="list-style-type: none"> <li>▪ Measure horizontal angles</li> <li>▪ Measure vertical angles</li> </ul>	1.0	4.0	5.0
24.	Perform traversing using Theodolite.	<p><b><u>Traversing:</u></b></p> <ul style="list-style-type: none"> <li>▪ Traversing (definition, purpose and types)</li> <li>▪ Field works</li> <li>▪ Methods (closed traverse only)</li> <li>▪ Angular misclosure and its adjustment</li> <li>▪ Traverse computation (consecutive coordinates and independent coordinates)</li> <li>▪ Closing error and relative precision</li> <li>▪ Balancing misclosure (Bowditch method and Transit method)</li> </ul>	1.5	15.0	16.5
25.	Plot traversing data.	<p><b><u>Traversing data:</u></b></p> <ul style="list-style-type: none"> <li>▪ Plotting scales</li> <li>▪ Preparation of grid</li> <li>▪ Plotting traverse</li> <li>▪ Maps and legends</li> <li>▪ Detailing</li> <li>▪ Procedure</li> </ul>	1.0	4.0	5.0
26.	Handle Total Station.	<p><b><u>Total Station (TS):</u></b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> </ul>	0.5	4.0	4.5

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
		<ul style="list-style-type: none"> <li>▪ Set up</li> <li>▪ Measurement of distance using TS</li> <li>▪ Measurement of angles using TS</li> </ul>			
27.	Perform traversing using TS.	<b><u>TS traversing:</u></b> <ul style="list-style-type: none"> <li>▪ Procedure</li> </ul>		10.0	10.0
28.	Set out horizontal/ vertical/ circular/ Parabolic/ transition curves.	<b><u>Setting out curves:</u></b> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Type of curves <ul style="list-style-type: none"> <li>• Horizontal</li> <li>• Vertical curve</li> <li>• Circular curve</li> <li>• Parabolic curve</li> <li>• Transition curve</li> </ul> </li> <li>▪ Methods <ul style="list-style-type: none"> <li>• Linear method</li> <li>• Angular method</li> </ul> </li> </ul>	2.0	14.0	16.0
		<b>Sub-total II</b>	<b>11.5</b>	<b>87</b>	<b>98.5</b>
		<b>Total (Sub-total I+ Sub-total II)</b>	<b>40</b>	<b>170</b>	<b>210</b>

#### Textbooks

- R. Agor, "Surveying and Leveling", Khanna Publication New Delhi.
- Dhakal B.B. and Karki B.K., "Engineering Surveying I &II", Heritage Publishers and Distributers Pvt. Ltd., Kathmandu, Nepal.

#### References

- N Basnet and M Basnet, "Basic Surveying – I & II", Benchmark Education Support Pvt. Ltd., Tinkune Kathmandu and Rajmati Press, Lalitpur.
- S K Duggal, "Surveying" Vol I and II, Tata MC Graw Hill Publishing.
- Dr. B. C Punmia, " Surveying " Vol I and II, Laxmi Publication New Delhi.

## Computer Application and Computer Aided Drafting

**Total:** 140 hours  
**Theory:** 30 hours  
**Practical:** 110 hours

### Course Description

This course is divided into two parts. The first part of this course intends to impart the knowledge and skills on basic computing. It includes the use of documents, spreadsheets and presentations slides by using computer application packages.

Similarly, the second part of this course is designed to provide knowledge and skills on CAD software application techniques for designing, developing, creating and constructing various technical and engineering drawings.

### Course Objectives

After completion of this course, students will able to:

1. Acquaint concept of computer system computer peripheral, operating system and application software;
2. Use different computer application packages;
3. Prepare documents, spreadsheets, presentations slides and database management sheets;
4. Describe the significant of CAD software in the engineering;
5. Apply CAD software designing, developing, creating and constructing various technical and engineering drawing; and
6. Apply CAD software in editing objects and annotate various drawings.

### Part I: Computer Application

#### Mode I: Computer System

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
1.	Identify computer peripheral.	<b><u>Fundamentals of computer:</u></b> <ul style="list-style-type: none"> <li>▪ Input and output devices</li> <li>▪ Central processing unit CPU</li> <li>▪ Memory unit</li> <li>▪ Auxiliary storage devices</li> <li>▪ Various ports</li> </ul>	0.5	1.0	1.5
2.	Install operating system.	<b><u>Operating system:</u></b> <ul style="list-style-type: none"> <li>▪ Operating system                             <ul style="list-style-type: none"> <li>• Definition</li> <li>• Role</li> <li>• Types</li> <li>• Installation process</li> </ul> </li> <li>▪ Function of DOS Commands (COPY, REN, DIR, TYPE, CD, MD and BACKUP)</li> </ul>	0.5	4	4.5
3.	Install Application/ Driver software.	<b><u>Application/driver software:</u></b>	1	2	3

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
		<ul style="list-style-type: none"> <li>▪ Difference between application software and device driver</li> <li>▪ Introduction of Office package and various applications under it</li> <li>▪ Uses of antivirus program.</li> <li>▪ Installation process of application/driver software</li> <li>▪ Features of Control Panel</li> </ul>			
<b>Sub-total I</b>			<b>2</b>	<b>7</b>	<b>9</b>

### Module II: Preparing Document Using Word Processing Packages

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
4.	Perform document typing.	<u><b>Document typing:</b></u> <ul style="list-style-type: none"> <li>▪ Word Processing application <ul style="list-style-type: none"> <li>• Concept</li> <li>• Toolbar / Menu</li> <li>• Open/save/exit</li> <li>• Process of typing document</li> <li>• Concept of font, size, paragraph, headings, justification</li> </ul> </li> </ul>	1	2.0	3
5.	Setup Page in Word Processing.	<u><b>Word processing:</b></u> <ul style="list-style-type: none"> <li>▪ Features and attributes of “Page Setup” Box.</li> <li>▪ Page margins, orientation and columns</li> <li>▪ Use of Breaks, Line numbers and Hyphenation</li> </ul>	1	2	3
6.	Insert Object/ picture/photos.	<u><b>Object/picture /photo:</b></u> <ul style="list-style-type: none"> <li>▪ Process of Inserting Object/Picture/Photo</li> </ul>	2	1.0	4
7.	Insert Header and Footer.	<u><b>Header and footer:</b></u> <ul style="list-style-type: none"> <li>▪ Difference between Header and Footer</li> <li>▪ Application of different header and footer in different pages</li> </ul>		1.00	
8.	Insert table.	<u><b>Table:</b></u> <ul style="list-style-type: none"> <li>▪ Concept of row and column</li> <li>▪ Process to inserting table</li> <li>▪ Table borders and shades</li> </ul>		1.00	
<b>Sub-total II</b>			<b>4</b>	<b>7</b>	<b>11</b>



### Module III: Preparing Spreadsheets Using Spreadsheet Package

S. N.	Task Statements	Related technical knowledge	Time (Hours)		
			T	P	Total
9.	Create worksheet.	<p><b><u>Spreadsheet application:</u></b></p> <ul style="list-style-type: none"> <li>▪ Concept and uses</li> <li>▪ Interface</li> <li>▪ Open and saving spreadsheet and exit</li> <li>▪ Concept of column, row, cell, workbook, worksheet, labels, borders, values, dates and formulas</li> </ul>	1	2	3
10.	Analyze data using basic formula/function.	<p><b><u>Formula and function:</u></b></p> <ul style="list-style-type: none"> <li>▪ Definition of operators</li> <li>▪ Function/formula <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Use</li> <li>• Types</li> </ul> </li> <li>▪ Cell Reference <ul style="list-style-type: none"> <li>• Relative</li> <li>• Absolute</li> </ul> </li> </ul>	1	2	3
11.	Create Chart/Graph.	<p><b><u>Chart and graphs:</u></b></p> <ul style="list-style-type: none"> <li>▪ Graph and Charts <ul style="list-style-type: none"> <li>• Concepts</li> <li>• Types</li> <li>• Process</li> </ul> </li> </ul>	2	1.00	6.0
12.	Filter data.	<p><b><u>Data filter:</u></b></p> <ul style="list-style-type: none"> <li>▪ Filter <ul style="list-style-type: none"> <li>• Concept</li> <li>• Applications of filter</li> </ul> </li> </ul>		1.00	
13.	Sort data.	<p><b><u>Data sorting:</u></b></p> <ul style="list-style-type: none"> <li>▪ Sorting <ul style="list-style-type: none"> <li>• Concept</li> <li>• Purposes and benefits of sorting</li> </ul> </li> </ul>		1.00	
14.	Setup page in spreadsheet.	<p><b><u>Page setup:</u></b></p> <ul style="list-style-type: none"> <li>▪ Features and attributes of “Page Setup” Box</li> <li>▪ Page margins, orientation, size and columns</li> </ul>		1.00	
<b>Sub-total III</b>			<b>4</b>	<b>8</b>	<b>12</b>

#### Module IV: Presentation Creation Using Presentation Package

S. N.	Task Statements	Related Technical Knowledge	Time (Hrs.)		
			T	P	Total
15.	Prepare master slide.	<b><u>Master slide:</u></b> <ul style="list-style-type: none"> <li>▪ Presentation Application               <ul style="list-style-type: none"> <li>• Concept and use</li> <li>• Tools and Menu</li> <li>• Introduction of slides and master slides</li> <li>• Use of master slide</li> <li>• Process to prepare master slide including formatting and editing</li> </ul> </li> </ul>	1	1	2
16.	Prepare slides.	<b><u>Slides:</u></b> <ul style="list-style-type: none"> <li>▪ Process to insert Text, Pictures/Objects/ Sound and Graphs and Charts</li> </ul>	1	1	2
17.	Animate the content of slide.	<b><u>Animation:</u></b> <ul style="list-style-type: none"> <li>▪ Definition</li> <li>▪ Application</li> <li>▪ Difference between transition and animation.</li> </ul>	1	1	2
18.	Perform On-screen presentation.	<ul style="list-style-type: none"> <li>▪ On screen projection.</li> <li>▪ Device connection process</li> </ul>		2	2
<b>Sub-total IV</b>			<b>3</b>	<b>5</b>	<b>8</b>
<b>Total (Sub-total I+ Sub-total II+ Sub-total III Sub-total IV)</b>			<b>14</b>	<b>27</b>	<b>42</b>

#### Part II: Computer Aided Drafting (CAD)

##### Module: I Introduction to Computer Aided Drafting (CAD) Software

S. N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
19.	Install the CAD Software.	<b><u>Computer Aided Drafting (CAD):</u></b> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Different type of CAD Software</li> <li>▪ System required for CAD</li> </ul>	0.5	5	5.5
20.	Startup Computer Aided Drafting (CAD) software.	<b><u>Startup of CAD:</u></b> <ul style="list-style-type: none"> <li>▪ Introduction of CAD start menu</li> <li>▪ Display modification</li> <li>▪ Toolbar Arrangement</li> <li>▪ Management of unit &amp; limit</li> <li>▪ Start, organize and save file</li> <li>▪ Introduction of CAD graphics window including screen layout, pull-down menus, screen icons,</li> </ul>	0.5	2	2.5

S. N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
		command line and dialogue boxes			
21.	Setup a drawing.	<b><u>Setting up a drawing:</u></b> <ul style="list-style-type: none"> <li>▪ Starting a drawing from scratch, using wizard and, using &amp; creating a template file</li> <li>▪ Preferences Setting (units &amp; scale)</li> </ul>	1	2	3
<b>Sub-total I</b>			<b>2</b>	<b>9</b>	<b>11</b>

### Module II: Creating Geometric Shapes using Draw Command Tools CAD Software

S. N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
22.	Draw line.	<b><u>Line drawing:</u></b> <ul style="list-style-type: none"> <li>▪ Coordinate systems</li> <li>▪ Types of activating draw command</li> <li>▪ Start &amp; end point of line</li> <li>▪ Methods of drawing line</li> <li>▪ Process to draw line</li> </ul>	2.0	1.0	9
23.	Draw rectangle.	<b><u>Rectangle drawing:</u></b> <ul style="list-style-type: none"> <li>▪ Method of drawing rectangle</li> </ul>		1.	
24.	Draw arc.	<b><u>Arc drawing:</u></b> <ul style="list-style-type: none"> <li>▪ 3 points method</li> <li>▪ Start Center method</li> <li>▪ Start End method</li> <li>▪ Center Start method</li> </ul>		1.	
25.	Draw circle.	<b><u>Circle drawing:</u></b> <ul style="list-style-type: none"> <li>▪ Center Radius method</li> <li>▪ Center Diameter method</li> <li>▪ 2P method</li> <li>▪ 3P method</li> <li>▪ Tan, Tan Radius method</li> <li>▪ Tan, Tan, Tan method</li> </ul>		1.0	
26.	Draw polygon.	<b><u>Polygon drawing:</u></b> <ul style="list-style-type: none"> <li>▪ Center</li> <li>▪ Edge</li> <li>▪ Inscribed and circumscribed</li> </ul>		1.5	
27.	Draw ellipse.	<b><u>Ellipse drawing:</u></b> <ul style="list-style-type: none"> <li>▪ Ellipse in rectangular snap</li> <li>▪ center radius method</li> <li>▪ Center diameter method</li> <li>▪ Ellipse in isometric method</li> </ul>		1.5	
<b>Sub-total II</b>				<b>2.0</b>	

### Module III: Editing of Objects Using CAD Software

S. N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
28.	Relocate object using Move command.	<b><u>Move command:</u></b> <ul style="list-style-type: none"> <li>▪ Object selection method</li> <li>▪ Functions of commands <ul style="list-style-type: none"> <li>• Erase, Trim, Break, Copy, Mirror, Offset, Array, Move, Rotate, Scale, Stretch, Lengthen, Extend, Chamfer, Fillet</li> </ul> </li> </ul>	1.0	1.0	2.0
29.	Relocate object using rotate command.	<b><u>Rotate command:</u></b> <ul style="list-style-type: none"> <li>▪ Definition of rotation angle</li> <li>▪ Reference Point</li> </ul>	0.5	1.5	3.5
30.	Duplicate object using Copy command.	<b><u>Copy command:</u></b> <ul style="list-style-type: none"> <li>▪ Differences between multiple copy and Single copy</li> <li>▪ Process for duplicating object using copy command</li> </ul>		1.5	
31.	Duplicate object using Mirror command.	<b><u>Mirror command:</u></b> <ul style="list-style-type: none"> <li>▪ Purpose</li> <li>▪ Method and Options available</li> </ul>	0.5	1.5	2
32.	Duplicate object using Offset command	<b><u>Offset command:</u></b> <ul style="list-style-type: none"> <li>▪ Options available</li> <li>▪ Methods of offsetting</li> </ul>	0.5	1.0	1.5
33.	Duplicate object using Array command	<b><u>Array command:</u></b> <ul style="list-style-type: none"> <li>▪ Difference between Rectangular Array and Polar Array</li> <li>▪ Description of Rows, Columns and Distance, Center point, number, angle and rotation</li> <li>▪ Methods of arraying</li> </ul>	1.0	3.5	4.5
34.	Modify object using trim command.	<b><u>Trim command:</u></b> <ul style="list-style-type: none"> <li>▪ Cutting edge</li> <li>▪ Options available for trimming object (project, edge, undo)</li> </ul>	0.5	1.0	1.5
35.	Modify object using extend command.	<b><u>Extend command:</u></b> <ul style="list-style-type: none"> <li>▪ Definition boundary edge</li> <li>▪ Procedure for modifying object using extend command</li> </ul>	0.5	1.0	1.5
36.	Modify object using fillet/chamfer command.	<b><u>Chamfer and fillet commands:</u></b> <ul style="list-style-type: none"> <li>▪ Free hand sketch of fillet</li> </ul>	0.5	1.0	1.5

S. N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
		<ul style="list-style-type: none"> <li>▪ Difference between Chamfer and Fillet</li> <li>▪ Options available for filleting object</li> </ul>			
		<b>Sub-total III</b>	<b>5</b>	<b>13</b>	<b>18</b>

#### Module IV: Annotating a Drawing with Text, Hatching and Dimensioning

S. N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
37.	Create a Layer.	<p><b><u>Layers:</u></b></p> <ul style="list-style-type: none"> <li>▪ Definition</li> <li>▪ Attributes and properties of a Layer (Line type, line weight, Global Scale Factor, Current Object Scale, Names, Of/Off, Freeze/Thaw, Lock/unlock, Color, Plot style, Plot/don't plot)</li> <li>▪ Process for creating a layer</li> </ul>	1	4	5
38.	Create text styles.	<p><b><u>Text style:</u></b></p> <ul style="list-style-type: none"> <li>▪ Difference between Single line text [TEXT] and Multiline Text [MTEXT]</li> <li>▪ Explanation of Style name, Font Name, Style and Height</li> <li>▪ Description of Font effect, Width factor and Oblique angle</li> <li>▪ Procedure for creating text styles</li> </ul>	1	4	5
39.	Fill area with hatching.	<p><b><u>Hatching:</u></b></p> <ul style="list-style-type: none"> <li>▪ Define</li> <li>▪ Importance</li> <li>▪ Differences of ISO Hatch Pattern, User Defined Hatch Pattern, Pre-Defined Hatch and Associative Hatch</li> <li>▪ Explanation of Boundary set, copying of hatch properties, pick point, hatch angle, scale, pattern, and object selection</li> </ul>	1	4	5
40.	Add dimensions to a drawing.	<p><b><u>Dimensioning:</u></b></p> <ul style="list-style-type: none"> <li>▪ Interpretation of dimension elements (dimension text,</li> </ul>	1	6	7

S. N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
		lines and arrowheads, leader, extension lines, units, tolerance and center marks) <ul style="list-style-type: none"> <li>▪ Types of dimension (linear, aligned, ordinate, radius, diameter, angular, baseline and continue)</li> </ul>			
		<b>Sub-total IV</b>	<b>4</b>	<b>18</b>	<b>22</b>

### Module V: Creating Output

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
41.	Work with layout.	<u><b>Layouts:</b></u> <ul style="list-style-type: none"> <li>▪ Properties</li> <li>▪ Arranging paper size</li> <li>▪ Prepare margin and title</li> <li>▪ Use and properties of viewport</li> </ul>	1	5	6
42.	Configure Plotters/Printers.	<u><b>Configuration:</b></u> <ul style="list-style-type: none"> <li>▪ Plotter Manager</li> <li>▪ Plot Style Manager</li> <li>▪ Printer/Plotter installation process</li> </ul>	1	6	7
43.	Plot the drawing.	<u><b>Drawing plotting:</b></u> <ul style="list-style-type: none"> <li>▪ Paper size and paper units, drawing orientation, plot area and plot scale, plot offset</li> <li>▪ Process for printing a drawing</li> </ul>	1	5	6
		<b>Sub-total V</b>	<b>3</b>	<b>16</b>	<b>19</b>

### Module VI: Project Works

S. N.	Projects /Task Statements	Time (Hours)		
		T	P	Total
44.	Draft the Simple architectural drawing of single storeyed two roomed residential building including four elevations, plan, and section in standard paper size with name plate of municipal standard using above commands.		<b>20</b>	<b>20</b>
	<b>Sub-total VI</b>		<b>20</b>	<b>20</b>
	<b>Total (Sub-total I+ Sub-total II+ Sub-total III+ Sub-total IV+ Sub-total V +Sub-total VI)</b>	<b>30</b>	<b>110</b>	<b>140</b>

## **Textbooks**

- Rajaraman, “*Fundamentals of Computers*”, Prentice-Hall of India.
- Mastering Auto CAD 2019 and AutoCAD LT 2019 by George Omura, SYBEX Publisher.

## **References**

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- S Saxena, “*A First Course in Computers*”, Vikash Publishing
- Winn Rosch, “Hardware Bible.”
- Noel Kalicharan, “Introduction to computer Studies”, Cambridge Low Price Edition
- P.K Sinha, “Computer Fundamentals.”
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## Basic Railway Technology

**Total:** 140 hours  
**Theory:** 30 hours  
**Practical:** 110 hours

### Course Description

This course is designed to impart knowledge and skills on railways transportation systems, railway civil infrastructure, and railways safety and security. Moreover, railways safety and security focus on safety measures, Security of Railway infrastructures, Railways accidents, and disaster issues.

### Course Objectives

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

1. Explain the scope and significance of railway transportation system;
2. Explain essential features and requirements of different types of crossings and signal system, maintenance of tracks and required procedures;
3. Describe railways geometry components and their construction;
4. Identify different components of railway as station and yard;
5. Apply safety measures for the infrastructure's security and safe operation; and
6. Perform rescue operation in accidental and disaster cases;

### Module I: Introduction to Railway Transportation

S.N.	Task Statements	Related Technical Knowledge	Time (Hrs.)		
			T	P	Total
1.	Acquaint railway transportation system. Identify railways.	<b><u>Railway transportation system:</u></b> <ul style="list-style-type: none"> <li>▪ Difference of railway from other transportation system</li> <li>▪ Railway system</li> <li>▪ different types of Railway system</li> <li>▪ Railway history in the world</li> <li>▪ History of railway in Nepal</li> <li>▪ Current scenario of railway in Nepal</li> </ul>	2	4	6
2.	Identify different engineering components of Railway. Identify components of railway track/railway gauges.	<b><u>Different engineering in railway:</u></b> <ul style="list-style-type: none"> <li>▪ Railway track                             <ul style="list-style-type: none"> <li>• Formation</li> <li>• Ballast</li> <li>• Sleeper</li> <li>• Rail</li> <li>• Fasteners</li> <li>• Railway gauge</li> </ul> </li> <li>▪ Electrical catenary system</li> <li>▪ Signaling and communication system</li> </ul>	2	8	10



S.N.	Task Statements	Related Technical Knowledge	Time (Hrs.)		
			T	P	Total
		<ul style="list-style-type: none"> <li>▪ Locomotive and Rolling Stocks</li> </ul>			
3.	Identify/draw alignment of railways lines. Identify/draw standard rail section.	<u><b>Railway alignment:</b></u> <ul style="list-style-type: none"> <li>▪ Importance of good alignment</li> <li>▪ Basic Requirement and selection of an ideal alignment</li> <li>▪ Criteria for selecting good alignment</li> </ul>	1	5	6
4.	Identify urban railway transportations.	<u><b>Urban railway transportation:</b></u> <ul style="list-style-type: none"> <li>▪ Metro rails</li> <li>▪ Monorails</li> <li>▪ Tramways</li> <li>▪ Automated Guided Railways</li> <li>▪ Light Rails</li> <li>▪ Tube rails (Hyperloop)</li> <li>▪ Surface, underground and elevated railways</li> </ul>	2	5	7
5.	List stages of new for Railway line construction.  Participate in/observe new Railway line construction work.	<u><b>Construction of new lines:</b></u> <ul style="list-style-type: none"> <li>▪ Land acquisition</li> <li>▪ Earthwork for formation</li> <li>▪ Construction of building and other facilities</li> <li>▪ Laying of plates including ballasting track</li> <li>▪ Opening of section to traffic</li> </ul>	2	8	10
6.	Identify/draw major structures (bridges, tunnel and viaducts).	<u><b>Major structures:</b></u> <ul style="list-style-type: none"> <li>▪ Introduction, purpose, classification and types <ul style="list-style-type: none"> <li>• Bridges</li> <li>• Tunnels</li> <li>• Viaducts</li> </ul> </li> </ul>	3	8	11
7.	Identify/prepare railway operation schedule.	<u><b>Railway operation:</b></u> <ul style="list-style-type: none"> <li>▪ Schedule</li> <li>▪ Manpower</li> <li>▪ Equipment's</li> <li>▪ Machines</li> <li>▪ Signs and signals</li> </ul>	1	8	9
<b>Sub-total I</b>			<b>13</b>	<b>46</b>	<b>59</b>

### Module II: Railway Infrastructure (Civil)

S.N.	Task Statements	Related Technical Knowledge	Time (Hrs.)		
			T	P	Total
8.	Identify/ draw drawings of railway geometry design	<u><b>Railway geometry:</b></u>	3	10	13

S.N.	Task Statements	Related Technical Knowledge	Time (Hrs.)		
			T	P	Total
	Identify geometric design of track.	<ul style="list-style-type: none"> <li>▪ Necessity and details of Geometric design</li> <li>▪ Design of track Gradients</li> <li>▪ Curves (Horizontal and Vertical)</li> <li>▪ Grade components on curves</li> <li>▪ Cant or Super elevation</li> <li>▪ Maximum and Permissible Speed</li> </ul>			
9.	Identify/observe/draw components of railway station.	<p><b><u>Railway station:</u></b></p> <ul style="list-style-type: none"> <li>▪ Function of Railway Station</li> <li>▪ Type of Railway station</li> <li>▪ Components of Railway station</li> <li>▪ Workforce in Railway station</li> <li>▪ Equipment's on Railway stations</li> <li>▪ Features of station platform</li> </ul>	2	6	8
10.	Identify/observe/draw railway yard.	<p><b><u>Railway Stations and Yards:</u></b></p> <ul style="list-style-type: none"> <li>▪ Facilities required at railway stations</li> <li>▪ Classification of railway stations</li> <li>▪ Requirements of station Yard</li> <li>▪ Function of railway Yard</li> <li>▪ Type of railway Yard</li> <li>▪ Components of railway Yard</li> <li>▪ Workforce in railway Yard</li> </ul>	2	6	8
11.	Identify/ draw level crossing structures.  Inspect/maintain level crossing	<p><b><u>Level crossing:</u></b></p> <ul style="list-style-type: none"> <li>▪ Level crossing</li> <li>▪ Classification of level crossing</li> <li>▪ Dimensions of level crossing</li> <li>▪ Accidents and remedial measures</li> <li>▪ Inspection and maintenance</li> </ul>	2	8	10
12.	Identify tools of railway track maintenance.  Maintain/observe railway tracks maintenance.	<p><b><u>Railway track maintenance:</u></b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Causes for maintenance</li> <li>▪ Types</li> <li>▪ Tools for railway track maintenance and their functions</li> </ul>	2	8	10

S.N.	Task Statements	Related Technical Knowledge	Time (Hrs.)		
			T	P	Total
		Surface defects and their remedial measures			
13.	Identify/draw catch sidings/ slip sidings	<b><u>Catch sidings and Slip sidings:</u></b> <ul style="list-style-type: none"> <li>▪ Catch sidings <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Purpose</li> <li>• Location</li> </ul> </li> <li>▪ Slip sidings <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Purpose</li> <li>• Location</li> </ul> </li> </ul>	1	6	7
<b>Sub-total II</b>			<b>12</b>	<b>44</b>	<b>56</b>

### Module III: Railway Safety and Security

S.N.	Task Statements	Related Technical Knowledge	Time (Hrs.)		
			T	P	Total
14.	Identify safety equipment.  Follow safety work procedure.	<b><u>Safety measures:</u></b> <ul style="list-style-type: none"> <li>▪ Safety equipment</li> <li>▪ Safety work procedures</li> <li>▪ Immediate actions for accidental issues</li> </ul>	1	6	7
15.	Install/connect/observe railway infrastructures security devices/measures.	<b><u>Security of railway infrastructures:</u></b> <ul style="list-style-type: none"> <li>▪ Railway Security Threat</li> <li>▪ Rail system</li> <li>▪ Track and Rails</li> <li>▪ Signaling system</li> <li>▪ Power supply assets, yards and equipment's warehouse</li> </ul>	2	6	8
16.	Respond to railway accidents /disaster.  Demonstrate rescue operation.	<b><u>Railway accidents and disaster:</u></b> <ul style="list-style-type: none"> <li>▪ Train Accident</li> <li>▪ Derailment and its cause</li> <li>▪ Restoration of traffic</li> <li>▪ Flood causeway</li> <li>▪ Disaster management</li> </ul>	2	8	10
<b>Total I</b>			<b>5</b>	<b>20</b>	<b>25</b>
<b>Total (Sub-total I +Sub-total II + Sub-total III)</b>			<b>30</b>	<b>110</b>	<b>140</b>

### References

- Satish Chandra and MM Agrawal, "Railway Engineering", Oxford University Press.
- Clifford F Bonnett, "Practical Railway Engineering", Imperial Collage Press, London.
- Operating Manual for Indian Railways, Government of India, Ministry of Railways (Railway Board).

## Railway Track Technology

**Total:** 140 hours  
**Theory:** 30 hours  
**Practical:** 110 hours

### Course Description

This course intends to provide basic knowledge and skills in fundamentals of Tract structure along with principle of formation of track and understanding its components. It also deals with inspection and maintenance of the track structure.

### Course Objectives

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

1. Explain the different parts of the rail track, their functions and its operation system with respect to construction and engineering applications;
2. Explain several components of permanent way and their functions;
3. Perform inspection and maintenance of different types of crossings and railway track;
4. Apply safety measures in railways track protection;
5. Describe way of increasing the life expectancy of track components and geometry; and
6. Evaluate the quality of all maintenance activities.

### Module 1: Introduction to Railway Track

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
1.	Draw free hand sketch of railway track/track components.	<b><u>Railway track:</u></b> <ul style="list-style-type: none"> <li>▪ Constituent of Railway track</li> <li>▪ Requirement of Good railway tracks</li> <li>▪ Classification of Routes</li> <li>▪ Different Rail Gauges</li> </ul>	1	3	4
2.	Identify different types of rails.  Draw rails.	<b><u>Rails:</u></b> <ul style="list-style-type: none"> <li>▪ Function of Rail</li> <li>▪ Different types of rails and their use</li> <li>▪ Standard Rail section</li> </ul>	2	2	4
3.	Draw sleepers.	<b><u>Sleepers:</u></b> <ul style="list-style-type: none"> <li>▪ Function of Sleepers</li> <li>▪ Different types of sleepers and their use</li> <li>▪ Handling of sleepers</li> <li>▪ Laying of sleepers</li> </ul>	1	3	4
4.	Identify/collect/transport ballast.	<b><u>Ballast:</u></b> <ul style="list-style-type: none"> <li>▪ Function of Ballast</li> <li>▪ Types of Ballast</li> <li>▪ Requirement of good ballast</li> <li>▪ Collection and transportation of ballasts</li> </ul>	1	3	4
5.	Construct fishplate rail joint.  Perform joints welding.	<b><u>Rail joints:</u></b> <ul style="list-style-type: none"> <li>▪ Introduction</li> </ul>	2	5	7

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
		<ul style="list-style-type: none"> <li>• Rail joint's function</li> <li>• Requirement of Ideal Rail joint</li> <li>▪ Types of joints               <ul style="list-style-type: none"> <li>• Fishplate joint</li> <li>• Welding joint</li> <li>• Modern welding's technique</li> </ul> </li> </ul>			
6.	Fasten sleepers.	<b><u>Fastening system:</u></b> <ul style="list-style-type: none"> <li>▪ Rail to sleeper Fastening</li> <li>▪ Elastic fastening and its types</li> </ul>	1	5	6
7.	Identify/ Points/Crossings.  Perform layout turnouts.	<b><u>Points and Crossing:</u></b> <ul style="list-style-type: none"> <li>▪ Function of turnouts</li> <li>▪ Different parts of turnout</li> <li>▪ Types of turnouts</li> <li>▪ Layout of turnout</li> </ul>	1	4	5
8.	Draw free hand sketch of components of drainage system.	<b><u>Draining water in railway components:</u></b> <ul style="list-style-type: none"> <li>▪ Requirement of good drainage system</li> <li>▪ Sources of water to be drained</li> <li>▪ Practical tips for good drainage system</li> <li>▪ Track drainage system</li> <li>▪ Drainage in railway stations</li> <li>▪ Drainage in station yard</li> <li>▪ Drainage in station yard</li> <li>▪ Sub surface drainage</li> </ul>	1	4	5
<b>Sub-total I</b>			<b>10</b>	<b>29</b>	<b>39</b>

### Module II: Track inspection

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
9.	Identify/handle track-measuring devices.	<b><u>Measuring devices:</u></b> <ul style="list-style-type: none"> <li>▪ Rail gauge</li> <li>▪ Straight edge and spirit level</li> <li>▪ Gauge cum level</li> <li>▪ Cant board</li> <li>▪ Mallet or wooden hammer</li> <li>▪ Canne-a-boule</li> <li>▪ T square</li> <li>▪ Stepped feeler gauge</li> </ul>	1	5	6
10.	Inspect/observe/measure railway track/track	<b><u>Railroad inspection:</u></b> <ul style="list-style-type: none"> <li>▪ Inspection requirements</li> </ul>	1	5	6

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
	components.  Measure track geometry/ rail deflection on load/off load	<ul style="list-style-type: none"> <li>▪ Creation of inspection records</li> <li>▪ Planning of inspection</li> <li>▪ Classes of track</li> <li>▪ Trolley inspection</li> <li>▪ Fast train inspection</li> <li>▪ Restoration or renewal of track under traffic</li> <li>▪ Measuring track geometry and rail deflection on load and off load</li> </ul>			
11.	Prepare track inspection schedule.  Perform regular track bed components inspection.  Measure track gauge.	<p><b><u>Roadbed inspection:</u></b></p> <ul style="list-style-type: none"> <li>▪ Drainage</li> <li>▪ Measurement of Ballast</li> <li>▪ Roadbed vegetation</li> <li>▪ Sleepers (crossies)</li> <li>▪ Measure track gauge</li> <li>▪ Schedule required for track inspection</li> </ul>	1	5	6
12.	Perform sampling/testing of ballast/aggregate (abrasion/ impact/ flakiness/specific gravity/water absorption)	<p><b><u>Laboratory testing:</u></b></p> <ul style="list-style-type: none"> <li>▪ Aggregate abrasion value</li> <li>▪ Aggregate impact value</li> <li>▪ Flakiness index</li> <li>▪ Specific gravity and water absorption test</li> </ul>	2	8	10
13.	Inspect/measure track geometry/components.	<p><b><u>Track geometry:</u></b></p> <ul style="list-style-type: none"> <li>▪ Checking of curve</li> <li>▪ Tangent and curve alignment</li> <li>▪ Maximum allowable speed on curves</li> <li>▪ Track Surface <ul style="list-style-type: none"> <li>• Runoff</li> <li>• Profile</li> <li>• Deviation in cross level</li> <li>• Difference in cross level</li> <li>• Harmonics</li> </ul> </li> </ul>	2	8	10
14.	Identify rail defects.  Handle rail-testing trolley.  Detect rail defects.	<p><b><u>Rail defects:</u></b></p> <ul style="list-style-type: none"> <li>▪ Visually inspect Rails</li> <li>▪ Inspect rail joints</li> <li>▪ Inspect for torch cut rail</li> <li>▪ Kraut Kramer Multi Probe Rail testing trolley</li> <li>▪ Ultrasonic Rail Flaw testing car</li> </ul>	2	7	9
15.	Perform turnout inspection.  Identify fittings of tongue	<p><b><u>Turnout inspection</u></b></p> <ul style="list-style-type: none"> <li>▪ Condition of tongue rail and stock rail</li> </ul>	2	7	9

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
	and stock rail.	<ul style="list-style-type: none"> <li>▪ Condition of fittings of tongue and stock rail</li> <li>▪ Gauge and cross level at switch assembly</li> <li>▪ Clearance between stock and tongue rails at the heel of the switch</li> <li>▪ Throw of switch</li> <li>▪ Cross level at turnouts</li> </ul>			
16.	Perform Fastening system Inspection	<u><b>Fastening system:</b></u> <ul style="list-style-type: none"> <li>▪ Fasteners clips</li> <li>▪ Bearing pads</li> <li>▪ Tie plates</li> </ul>	1	4	5
17.	Perform track patrolling.  Identify/measure track tolerances.	<u><b>Patrolling and track tolerances:</b></u> <ul style="list-style-type: none"> <li>▪ Gang patrol during abnormal rainfall or storm</li> <li>▪ Night patrolling during monsoon</li> <li>▪ Track parameters tolerances</li> <li>▪ Safety tolerances</li> <li>▪ Track tolerances for Good riding quality</li> </ul>	1	6	7
<b>Sub-total II</b>			<b>13</b>	<b>55</b>	<b>68</b>

### Module III: Track Maintenance

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
18.	Identify tracks maintenance tools.	<u><b>Maintenance tools:</b></u> <ul style="list-style-type: none"> <li>▪ Sleeper tong</li> <li>▪ Rail tong</li> <li>▪ Beater</li> <li>▪ Crowbar</li> <li>▪ Jim crow</li> <li>▪ Spanner</li> <li>▪ Wire claw or ballast rake</li> <li>▪ Phowrah (Shovel)</li> <li>▪ Auger</li> <li>▪ Box spanner</li> <li>▪ Wire basket</li> <li>▪ Pan iron motor</li> </ul>	1	5	6
19.	Identify weld track components.  Perform Air arc gouging/grinding.  Weld track components.	<u><b>Weld track components:</b></u> <ul style="list-style-type: none"> <li>▪ Inspection of welding equipment</li> <li>▪ Accessories used for welding track component</li> </ul>	1	8	9

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
		<ul style="list-style-type: none"> <li>▪ Preparation of track component for repair welding</li> <li>▪ Air arc gouging and grinding</li> <li>▪ Proper pre and post welding procedure</li> <li>▪ Welding technique on track components</li> <li>▪ Repair welding on track components with wire and stick</li> <li>▪ Proper finish grinding of track components</li> </ul>			
20.	Maintain sleepers	<b><u>Sleeper:</u></b> <ul style="list-style-type: none"> <li>▪ On track tamper</li> <li>▪ Off track tamper</li> <li>▪ Emergencies maintenance</li> </ul>	1	4	5
21.	Maintain turnouts.	<b><u>Turnouts:</u></b> <ul style="list-style-type: none"> <li>▪ Reconditioning of worn-out crossings</li> <li>▪ Functions</li> <li>▪ Set up (orientation, centering and leveling)</li> </ul>	2	4	6
22.	Perform track-relaying work.	<b><u>Rehabilitation and renewal of track:</u></b> <ul style="list-style-type: none"> <li>▪ Rail renewals</li> <li>▪ Execution of track renewal or track Relaying work</li> <li>▪ Mechanized relaying</li> <li>▪ Track renewals trains</li> <li>▪ Requirement of track material</li> </ul>	2	5	7
		<b>Sub-total III</b>	<b>7</b>	<b>26</b>	<b>33</b>
		<b>Total (Sub-total I + Sub-total II + Sub-total III)</b>	<b>30</b>	<b>110</b>	<b>140</b>

## References

- Satish Chandra and MM Agrawal, “Railway Engineering”, Oxford University Press.
- Clifford F Bonnett, “Practical Railway Engineering”, Imperial Collage Press, London.
- Operating Manual for Indian Railways, Government of India, Ministry of Railways (Railway Board).



## Estimating Costing and Supervision

**Total:** 210 hours  
**Theory:** 40 hours  
**Tutorial:** 170 hours

### Course Description

This course is designed into two parts viz., Estimating and Costing and Supervision. The first part intends to provide knowledge and skills in calculating quantities and costs of simple engineering structures. It also provides knowledge and skills on analyzing the rate of construction items including specifications. The second part, deals with supervisory techniques necessary to carrying out at construction sites and construction activities as well. It also imparts knowledge and skills about properties valuation

### Course Objectives

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

1. Acquaint with units of various items, measurement units of civil construction work and district rates systems;
2. Calculate quantities estimate and abstract of cost of simple engineering structures;
3. Calculate quantities estimate and abstract of cost of railroads
4. Apply current government accounting format and procedures for construction sites;
5. Analyze rates of different items of construction works;
6. Prepare complete quantities estimate and abstract of cost of load bearing building, simple RCC frame structure building and railroad;
7. Acquaint the concept of properties valuation system; and
8. Apply supervisory techniques for managing construction sites and controlling quality of construction works.

### Module1: Estimating Items of Construction Works/Quantity Estimate

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Tot
1.	Describe procedures of estimating.	<b><u>Procedures:</u></b> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Types of estimate</li> <li>▪ Unit of measurement for different items</li> <li>▪ Purpose of estimating</li> <li>▪ System of measurements</li> <li>▪ Data required for estimating</li> </ul>	1	2	3
2.	Illustrate/convert measurement units/systems.	<b><u>Measurement units:</u></b> <ul style="list-style-type: none"> <li>▪ Types of measuring units</li> <li>▪ Concept of S.I units</li> <li>▪ Conversion from imperial to metric system and vice versa.</li> </ul>	1	2	3
3.	Calculate geometrical shapes/ sizes.	<b><u>Geometrical shapes:</u></b> <ul style="list-style-type: none"> <li>▪ Perimeter</li> <li>▪ Area of rectangle, triangle, Trapezoid and circle</li> <li>▪ Volume of cube, Sphere, Pyramid, Cone, Cylinder</li> </ul>	1	4	5

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Tot
		<ul style="list-style-type: none"> <li>▪ Area &amp; Volume of irregular shapes</li> </ul>			
4.	Measure construction materials/ items.	<p><b><u>Construction materials/items:</u></b></p> <ul style="list-style-type: none"> <li>▪ Measurement Units of Construction Materials/Items</li> <li>▪ Measurement of dimension of Construction Materials/Items</li> </ul>	1	4	5
5.	Estimate quantity of earthwork.	<p><b><u>Earthwork:</u></b></p> <ul style="list-style-type: none"> <li>▪ Drawing and specification</li> <li>▪ Format for detailed estimate, taking out dimensions, and quantity</li> <li>▪ Estimating methods (long wall, short wall &amp; center line)</li> </ul>	1	8	9
6.	Estimate quantity of masonry footings.	<p><b><u>Masonry footing:</u></b></p> <ul style="list-style-type: none"> <li>▪ Drawing and specification for masonry (wall) footings</li> <li>▪ Items of work for footing construction, soling, PCC, brickwork, offsetting</li> <li>▪ T, 2T and 2T+300 for footings</li> <li>▪ Estimating methods (long wall, short wall &amp; center line)</li> </ul>	1	8	9
7.	Estimate quantity of superstructure wall of a building.	<p><b><u>Superstructure wall:</u></b></p> <ul style="list-style-type: none"> <li>▪ Drawing and specification of wall</li> <li>▪ Deduction (door and window opening) items</li> <li>▪ Estimating methods (long wall, short wall &amp; Centre line)</li> </ul>	1	5	6
8.	Estimate quantity of flooring works.	<p><b><u>Flooring works:</u></b></p> <ul style="list-style-type: none"> <li>▪ Drawing and specification of the flooring works</li> <li>▪ Estimate of different types of flooring (Concrete, Tiles, Timber &amp; Marbles)</li> </ul>	1	5	6
9.	Estimate quantity of RCC works.	<p><b><u>RCC works:</u></b></p> <ul style="list-style-type: none"> <li>▪ Density of R-Bar and concrete</li> <li>▪ Reinforcement details of Beam / Lintel/ Column /Slab</li> <li>▪ Reinforcement spacing, lapping, Hook, and bends</li> <li>▪ Development length</li> <li>▪ Procedure</li> </ul>	1	5	6
10.	Estimate quantity of plastering / punning/	<p><b><u>Finishing works:</u></b></p> <ul style="list-style-type: none"> <li>▪ Drawing and specification</li> </ul>	1	5	6

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Tot
	pointing/skirting works.	<ul style="list-style-type: none"> <li>▪ Procedure</li> </ul>			
11.	Estimate quantity of CGI sheet roofing works.	<p><b><u>CGI sheet:</u></b></p> <ul style="list-style-type: none"> <li>▪ Drawing and specification of roof works</li> <li>▪ Size of gauze of CGI sheet available in the market</li> <li>▪ Procedure</li> </ul>	1	5	6
12.	Estimate quantity of a single room/ two roomed building/ multi roomed residential building (Masonry/RCC).	<p><b><u>Masonry and RCC works:</u></b></p> <ul style="list-style-type: none"> <li>▪ Drawing and specification</li> <li>▪ Position of DPC, doors and windows, beams</li> <li>▪ Long wall and short wall method</li> <li>▪ Center line method</li> </ul>	1	5	6
13.	Estimate Railroads	<p><b><u>Railroad works:</u></b></p> <p>Estimate of</p> <ul style="list-style-type: none"> <li>▪ Earthworks by three methods <ul style="list-style-type: none"> <li>• Mid sectional area</li> <li>• Mean sectional area</li> <li>• Prismoid area</li> </ul> </li> <li>▪ Pitching of slopes</li> <li>▪ Level crossing</li> <li>▪ Laying railway tracks (rails, fish plates, fish bolt and nuts, sleepers, spikes, ballast)</li> <li>▪ Maintenance of railway tracks</li> </ul>	2	10	12
<b>Sub-total I</b>			<b>14</b>	<b>68</b>	<b>82</b>

### Module II: Rate Analysis

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Tot
14.	Illustrate rate analysis format/parameters.	<p><b><u>Rate analysis parameter:</u></b></p> <ul style="list-style-type: none"> <li>▪ Definition</li> <li>▪ Current district rate or rate of material</li> <li>▪ Format for rate analysis</li> <li>▪ Factor affecting rate analysis</li> <li>▪ Transportation rate related to capacity of vehicle</li> <li>▪ Procedure of rate analysis</li> </ul>	1	5	6
15.	Analyze rate for earthwork in excavation.	<p><b><u>Earthwork:</u></b></p> <ul style="list-style-type: none"> <li>▪ Types of earth works</li> <li>▪ Water charge, tools &amp; plants, overhead, contingency and VAT</li> </ul>	2	4	6
16.	Analyze rate of Plain Cement Concrete (PCC) works.	<p><b><u>PCC works:</u></b></p> <ul style="list-style-type: none"> <li>▪ Adopted ratios of PCC</li> </ul>	1	5	6

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Tot
		<ul style="list-style-type: none"> <li>▪ Dry volume and wet volume quantities of ingredients</li> <li>▪ Norms &amp; current district rates</li> <li>▪ Explanation of water charge, tools &amp; plants, overhead, contingency and VAT</li> </ul>			
17.	Analyze rate for steel reinforcement works.	<b><u>Reinforcement works:</u></b> <ul style="list-style-type: none"> <li>▪ Drawing and specification</li> <li>▪ Procedure of Cutting, Bending, Binding and positioning of the steel reinforcement works</li> <li>▪ Tools &amp; plants, overhead, contingency and VAT</li> </ul>	1	5	6
18.	Analyze rate for centering/formwork.	<b><u>Centering and formwork:</u></b> <ul style="list-style-type: none"> <li>▪ Providing, fixing and dismantling centering and formwork</li> <li>▪ Explanation of water charge, tools &amp; plants, overhead, contingency and VAT</li> </ul>	1	5	6
19.	Analyze rate for rubble stone masonry in cement sand mortar.	<b><u>Ruble stone masonry:</u></b> <ul style="list-style-type: none"> <li>▪ Drawing and specification</li> <li>▪ Water charge, tools &amp; plants, overhead, contingency and VAT</li> </ul>	1	5	6
20.	Analyze rate of brick soling.	<b><u>Brick soling:</u></b> <ul style="list-style-type: none"> <li>▪ Units of measurement</li> <li>▪ Water charge, tools &amp; plants, overhead, contingency and VAT</li> </ul>	1	5	6
21.	Analyze rate for brick masonry work.	<b><u>Brick masonry</u></b> <ul style="list-style-type: none"> <li>▪ Number of bricks in per m<sup>3</sup></li> <li>▪ Ratio of volume of bricks and mortar</li> <li>▪ Norms and current district rates</li> <li>▪ Water charge, tools &amp; plants, overhead, contingency and VAT</li> </ul>	2	4	6
22.	Analyze rate for Blocks/Aluminum/Grill Works/ Railing Works/ UPVC/Painting/Tiles flooring/Marble flooring/Water proofing.	<b><u>Miscellaneous works:</u></b> <ul style="list-style-type: none"> <li>▪ Drawing and specification</li> <li>▪ Water charge, tools &amp; plants, overhead, contingency and VAT</li> </ul>	2	5	7
<b>Sub-total II</b>			<b>12</b>	<b>43</b>	<b>55</b>
<b>Total (Sub-total I + Sub-total II)</b>			<b>26</b>	<b>111</b>	<b>137</b>

### Module III: Property Valuation

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Tot
23.	Acquaint with property valuation.	<b><u>Introduction:</u></b> <ul style="list-style-type: none"> <li>▪ Definition</li> <li>▪ Purpose of valuation</li> <li>▪ Principle of valuation</li> <li>▪ Factor affecting the valuation</li> </ul>	1	4	3
24.	Prepare the valuation report of property (land and Building).	<b><u>Valuation report:</u></b> <ul style="list-style-type: none"> <li>▪ Methods of valuation</li> <li>▪ Gross income, Net income,</li> <li>▪ Outgoing, Scrap value, Salvage value</li> <li>▪ Sinking fund and depreciation</li> </ul>	2	6	8
<b>Sub-total I</b>			<b>3</b>	<b>10</b>	<b>13</b>

### Module IV: Supervision

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Tot
25.	Describe role of supervisor.	<b><u>Roles of supervisor:</u></b> <ul style="list-style-type: none"> <li>▪ Supervisor as               <ul style="list-style-type: none"> <li>• A builder's or employee's agent</li> <li>• Duties of supervisor</li> <li>• Relationships between client, consultant and contractor</li> </ul> </li> </ul>	1		1
26.	Prepare progress report/keep builder's diary.	<b><u>Progress report:</u></b> <ul style="list-style-type: none"> <li>▪ Daily work progress report</li> <li>▪ Monthly progress report</li> <li>▪ Definition of builder's diary</li> <li>▪ Supervisor's daily diary</li> <li>▪ Methods to entry diary</li> </ul>	1	5	6
27.	Prepare/maintain logbook.	<b><u>Logbook:</u></b> <ul style="list-style-type: none"> <li>▪ Log book and its uses</li> <li>▪ Format of log book</li> <li>▪ Maintaining site order book</li> <li>▪ Maintain lab Test log book</li> </ul>	1	5	6
28.	Prepare muster roll.	<b><u>Muster roll:</u></b> <ul style="list-style-type: none"> <li>▪ Muster roll</li> <li>▪ Entry methods</li> <li>▪ Types of workers (daily, seasonal and permanent)</li> <li>▪ Payment process of muster roll</li> </ul>	1	5	6
29.	Fill measurement book (M.B.).	<b><u>Measurement book:</u></b> <ul style="list-style-type: none"> <li>▪ Definition of measurement book.</li> </ul>	1	5	6

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Tot
		<ul style="list-style-type: none"> <li>▪ Importance of MB</li> <li>▪ Size of MB</li> <li>▪ Precautions in data entry in MB</li> <li>▪ Endorsement procedure of MB</li> </ul>			
30.	Prepare work schedule.	<u><b>Work schedule:</b></u> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Purpose</li> <li>▪ Method (Gantt/Bar chart)</li> </ul>	1	4	5
31.	Prepare running bill.	<u><b>Running bill:</b></u> <ul style="list-style-type: none"> <li>▪ Definition of bill</li> <li>▪ Types of bill</li> <li>▪ Definition of bill of quantities</li> <li>▪ Definition of abstract of cost</li> <li>▪ Retention money</li> <li>▪ Procedure</li> </ul>	1	4	5
32.	Participate in tendering/contract award procedures.	<u><b>Tendering/contract award:</b></u> <ul style="list-style-type: none"> <li>▪ Definition of contract and agreement</li> <li>▪ Definition of tender/tender notice and tender document</li> <li>▪ Difference between bid bond and performance bond</li> <li>▪ Procedure of bidder's evaluation</li> <li>▪ Contract approval procedure</li> <li>▪ Contract award</li> <li>▪ Contract clauses</li> </ul>	1	5	6
33.	Prepare final bill.	<u><b>Final bill:</b></u> <ul style="list-style-type: none"> <li>▪ Definition of final bill</li> <li>▪ Condition of final bill</li> <li>▪ Comparative chart (contract quantity and final bill quantity)</li> <li>▪ Payment procedure of government</li> <li>▪ Civil related ma.la.pa forms 500 series</li> </ul>	1	4	5
34.	Prepare work completion certificate.	<u><b>Completion certificate:</b></u> <ul style="list-style-type: none"> <li>▪ Virtual completion certificate</li> <li>▪ Midterm completion certificate</li> <li>▪ Final completion certificate</li> </ul>	1	4	5
35.	Carry out testing/commissioning of the construction works.	<u><b>Testing and commissioning:</b></u> <ul style="list-style-type: none"> <li>▪ Definition of maintenance period</li> </ul>	1	8	9

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Tot
		<ul style="list-style-type: none"> <li>▪ Types of maintenance</li> <li>▪ Reimbursement of performance bond, bank guarantee and retention money</li> <li>▪ Testing and commissioning the work done (procedure)</li> </ul>			
		<b>Sub-total II</b>	<b>11</b>	<b>49</b>	<b>60</b>
		<b>Total (Sub-total I+ Sub-total II)</b>	<b>14</b>	<b>59</b>	<b>73</b>
		<b>TOTAL</b>	<b>40</b>	<b>170</b>	<b>210</b>

## References

1. Amarjit Aggarwal "Civil estimating quantity surveying and valuation" Katson Publishing House, Ludhiyana, 1985
2. P.K. Guha "Quantity Surveying" (Principles and application Khanna Publishers
3. M. Charkraborti "Estimating, costing, specifications and valuation in civil engineering"
4. G.S. Berdie "Text book of estimating and costing".
5. B.N Dutta "Estimating and costing, specification and valuation"

## Railway EST (Electronic, Signaling and Telecommunication)

**Total:** 210 hours

**Theory:** 40 hours

**Practical:** 170 hours

### Course Description

This course provides skills and knowledge related to Electronic Components that are required for the setting up and operation of railway signaling and telecommunication equipment.

### Course Objectives

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

1. Explain the scope and importance of electronic, signaling and telecommunication systems;
2. Apply safety standards for railway operation;
3. Identify and use various electronic components;
4. Simulate and Draw Railway tracks including different components;
5. Perform signaling devices installation works;
6. Install telecommunication components; and
7. Use passenger reservation system.

### Module I: Basic Electronic

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Tot
1.	Calculate/ check the value of fixed and variable resistor.	<b><u>Variable resistor:</u></b> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Purpose</li> <li>▪ Importance and uses</li> <li>▪ Types</li> <li>▪ Function</li> <li>▪ Setting procedure</li> <li>▪ Advantage                             <ul style="list-style-type: none"> <li>• Log book/ Work report</li> </ul> </li> </ul>	2	10	12
2.	Measure the value of capacitor.	<b><u>Capacitor:</u></b> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Importance and uses</li> <li>▪ Types</li> <li>▪ Advantage</li> <li>▪ Procedure</li> </ul>	1	8	9
3.	Measure the value of Inductor.	<b><u>Inductor:</u></b> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Importance and uses</li> <li>▪ Types</li> <li>▪ Advantage</li> <li>▪ Procedure</li> </ul>	1	8	9
4.	Measure voltage/ current in series/ parallel circuit.	<b><u>Electric circuits:</u></b> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Types (series, parallel &amp; combined)</li> <li>▪ Circuit symbols</li> </ul>	1	6	7



S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Tot
		<ul style="list-style-type: none"> <li>▪ Circuit Diagram Connection procedure</li> <li>▪ Safety precautions</li> </ul>			
5.	Plot Volt- Ampere Characteristics of Silicon/Germanium diode with the help of Ammeter/Voltmeter measurement values.	<p><b><u>Semiconductor:</u></b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Importance and uses</li> <li>▪ Types</li> <li>▪ Function</li> <li>▪ Advantage</li> </ul> <p><b><u>Biases Introduction</u></b></p> <ul style="list-style-type: none"> <li>▪ Importance and uses</li> <li>▪ Types</li> <li>▪ Advantage</li> </ul> <p><b><u>DC power supply, V/I curve circuit:</u></b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Importance and uses</li> <li>▪ Connection</li> <li>▪ Advantage</li> </ul>	3	8	11
6.	Plot Volt- Ampere Characteristics of Zener diode. Determine Zener breakdown voltage in reverse biased condition with the help of Ammeter/Voltmeter measurement values	<p><b><u>Zener Diode:</u></b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Uses/application</li> <li>▪ Function</li> <li>▪ Advantage</li> </ul> <p><b><u>V/I curve:</u></b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Importance and uses</li> <li>▪ Advantage</li> <li>▪ Procedure</li> </ul>	2	8	10
7.	Connect the circuit for Full Wave Bridge Rectifier Determine Ripple factor and percentage of regulation in Full Wave Bridge Rectifier Circuit with and without Capacitor filter.	<p><b><u>Rectifier Circuits:</u></b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Importance and uses</li> <li>▪ Types</li> <li>▪ Function</li> <li>▪ Advantage</li> <li>▪ Procedure</li> </ul> <p><b><u>Transformer (6-0-6), oscilloscope:</u></b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Uses</li> <li>▪ Types</li> <li>▪ Advantage</li> <li>▪ Connection</li> <li>▪ Procedure</li> </ul>	2	8	10
8.	Connect the bias Circuit for common base/emitter/collector amplifier.	<p><b><u>Transistor, biasing, data, amplification switching:</u></b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Uses/application</li> </ul>	2	10	12

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Tot
	Plot the input/output characteristics in common base/emitter/collector configuration.	<ul style="list-style-type: none"> <li>▪ Types</li> <li>▪ Function</li> <li>▪ Advantage</li> <li>▪ Connection</li> <li>▪ Procedure</li> </ul>			
9.	Construct voltage regulators using Zener diode.	<b><u>Soldering Iron, Lead, PCB plate, FeCl3:</u></b> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Importance and uses</li> <li>▪ Function</li> <li>▪ Advantage</li> <li>▪ Procedure</li> </ul>	2	8	10
10.	Connect the circuit for NOT, OR, AND, NAND, NOR, Logic gate. Draw the true table of NOT, OR, NAND, NOR Logic gate.	<b><u>IC, Gate:</u></b> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Importance and uses</li> <li>▪ Types</li> <li>▪ Function</li> <li>▪ Circuit diagram</li> <li>▪ Advantage</li> <li>▪ Procedure</li> </ul> <b><u>DC supply to the gate, bread board:</u></b> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Uses</li> <li>▪ Advantage</li> <li>▪ Importance</li> </ul>	3	12	15
11.	Construct NPN Relay Switch circuit	<b><u>Relay:</u></b> <ul style="list-style-type: none"> <li>▪ Construction</li> <li>▪ Working Principle</li> <li>▪ Types</li> <li>▪ Uses</li> </ul>	1	4	5
<b>Sub-total I</b>			<b>20</b>	<b>90</b>	<b>110</b>

### Module II: Railway Signaling

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
12.	Follow the Safety considerations/regulations in Railway operations.	<b><u>Safety considerations:</u></b> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Types</li> <li>▪ Safety signs, signals and symbols</li> <li>▪ Identification</li> <li>▪ Safety precaution measures</li> <li>▪ On Track and on Board</li> <li>▪ International Standards</li> </ul>	1	4	5

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
		<ul style="list-style-type: none"> <li>▪ Track Utilization through Signaling</li> </ul>			
13.	Design/Draw Railway Track with Points	<p><b><u>Designing of railway track:</u></b></p> <ul style="list-style-type: none"> <li>▪ Point Principle and purpose,</li> <li>▪ Point elements,</li> <li>▪ Point geometry,</li> <li>▪ Track and Stations points</li> <li>▪ Point operation,</li> <li>▪ Crossing</li> </ul>	1	8	9
14.	Operate/Draw Train Detection Circuits (Axle Counter/Track Circuit)	<p><b><u>Train detection system:</u></b></p> <ul style="list-style-type: none"> <li>▪ Block section</li> <li>▪ Block equipment:</li> <li>▪ Track circuit and types,</li> <li>▪ Axle counters</li> </ul>	1	8	9
15.	Identify Signals/Draw Block Diagram of Signaling System Architecture/ Electronic Interlocking System Architecture	<p><b><u>Signals:</u></b></p> <ul style="list-style-type: none"> <li>▪ Types: Fixed, Stop, Permissive, Repeater, Call on Signal, Subsidiary</li> <li>▪ Signal Aspects: Red, Yellow, Double Yellow, Green</li> <li>▪ Signaling posts</li> <li>▪ Signaling system Architecture <ul style="list-style-type: none"> <li>• Block diagram,</li> <li>• Component Description</li> </ul> </li> <li>▪ Electronic interlocking</li> <li>▪ System architecture <ul style="list-style-type: none"> <li>• Block diagram,</li> <li>• Component Description</li> </ul> </li> </ul>	3	8	11
16.	Operate Interlocking Simulator	<p><b><u>Interlocking System:</u></b></p> <ul style="list-style-type: none"> <li>▪ Interlocking principle</li> <li>▪ Interlocking standards</li> <li>▪ Panel interlocking</li> <li>▪ Route relay interlocking</li> <li>▪ Solid State interlocking</li> <li>▪ Interlocking at level Crossing gate</li> </ul>	2	4	8
17.	Draw the block diagram of Data Logger	<p><b><u>Data Logger:</u></b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Descriptions of each Component</li> <li>▪ Uses</li> </ul>	1	6	7
		<b>Sub-total II</b>	<b>9</b>	<b>38</b>	<b>47</b>

### Module III: Railway Telecommunication

S.N.	Task Statements	Related Technical Knowledge	Time Hours		
			T	P	Total
18.	Identify/install the Telecommunication components (LAN cable, RJ-45, RJ-15, optical fiber cable, optical fiber splicing technique).  Measure optical signal by OTDR	<b><u>Identification of Telecommunication:</u></b> <ul style="list-style-type: none"> <li>▪ Railway Telecommunication network and principle</li> <li>▪ Control Communication</li> <li>▪ Block Communication</li> <li>▪ Level Crossing Gate Communication</li> <li>▪ Emergency Communication</li> <li>▪ Administrative and data Communication,</li> <li>▪ Mobile Communication</li> <li>▪ Communication for Passenger information System</li> </ul>	3	10	13
19.	Identify/ install transmission system	<b><u>Installation of Transmission Network:</u></b> <ul style="list-style-type: none"> <li>▪ Optical cable line</li> <li>▪ MW/VHF communication</li> <li>▪ Underground RE cable overhead alignment</li> <li>▪ SDH/PDH</li> <li>▪ Telephone switching system</li> <li>▪ Clock system</li> <li>▪ Broadcasting system</li> <li>▪ Ticketing system</li> <li>▪ Dispatching system</li> <li>▪ Communication power supply</li> <li>▪ Lightning protection and grounding</li> <li>▪ Procedure</li> <li>▪ Safety precautions</li> </ul>	3	12	15
<b>Sub-total III</b>			<b>6</b>	<b>22</b>	<b>28</b>

### Module IV: Railway EST Maintenance

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
20.	Identify/handle maintenance tools/instruments and equipment.	<b><u>Maintenance tools, instruments and equipment:</u></b> <ul style="list-style-type: none"> <li>▪ <b>Electronic components maintenance tools, instruments and equipment</b> Megger, Portable Voltmeter/Ammeter, Current Transformer, Vacuum Tube Voltmeter, Cathode Ray Oscilloscope, High Voltage</li> </ul>	3	3	6

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
		Tester, Contact Pyrometer, Ultra Sonic Track Detector, Electric Coil Tester, Portable Relay Testing Kit, Wheat Stone Bridge, Universal Multimeter <ul style="list-style-type: none"> <li>▪ <b>Signal and Telecom Maintenance tools, instruments and equipment</b>                Advanced Communication Tester, OTDR, PMD Analyzer, Fluke Network Aircheck Tester, TSMA Scanner</li> <li>▪ Function of tools</li> <li>▪ Identification</li> </ul> Safety precautions			
21.	Test/repair/replace electronics components (Relay System, Silicon/Germanium diode, Zener diode, Transistor, Inductor, Capacitor, Signaling Bulbs, Fan, AC, and Transformer etc.).	<b><u>Electronic components Maintenance:</u></b> <ul style="list-style-type: none"> <li>▪ Electronics components               <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Identification</li> </ul> </li> <li>▪ Testing tools, instruments and equipment</li> <li>▪ Testing procedure</li> <li>▪ Maintenance procedure</li> <li>▪ Safety precautions</li> </ul>	1	9	10
22.	Test/repair/replace Signaling/Telecom Components (fiber installation, Copper Cable, Control Units, Wireless equipment, Rail Signaling, CCTV, Telephone network connectivity, Telephone equipment, Railway Track Circuit and Axle Counter).	<b><u>Signal and telecom maintenance:</u></b> <ul style="list-style-type: none"> <li>▪ Telecom components               <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Identification</li> </ul> </li> <li>▪ Testing tools, instruments and equipment</li> <li>▪ Testing procedure</li> <li>▪ Safety precautions</li> </ul>	1	8	9
23.	<b>Sub-total IV</b>		<b>5</b>	<b>20</b>	<b>25</b>
24.	<b>Total (Sub-total I+ Sub-total II+ Sub-total II+ Sub-total IV)</b>		<b>40</b>	<b>170</b>	<b>210</b>

### References

- Principle of Electronics- V.K. Methata
- Digital Fundamental- Floyd
- Modern Digital and Analog Communication System-B.P. Lathi
- Signals and Systems- Alan V. Oppenheim
- Digital Logic and Computer Design- M. Morris Mano
- Microelectronic Circuit- Adel Sedra and Kenneth C. Smith

## Locomotive and Rolling Stocks

**Total:** 140 hours  
**Theory:** 30 hours  
**Practical:** 110 hours

### Course Description

This course is designed to deliver basic skills and of Locomotives and Rolling Stocks. It especially provides fundamentals of locomotives and rolling stocks, its development, current technologies and operation principles. The course will help to lay foundation of rolling stock technical work in the future.

### Course Objectives

After completion of this course, students will be able to know:

1. Explain concept of locomotive and rolling stock;
2. State principle of operation and structure of Internal Combustion Engine;
3. State principles of operation and structure of diesel and electric locomotives;
4. Describe structure and principle of various types of Bogies;
5. Explore development of Locomotive technology and current status; and
6. Perform installing, adjusting and repairing of components locomotive stocks and rolling stocks.

### Module I: Introduction

S. N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
1.	Draw a free hand sketch of Train  Identify / classify Locomotives.	<b>Train:</b> <ul style="list-style-type: none"> <li>▪ <b>Classification:</b> <ul style="list-style-type: none"> <li>• According to Traction Power                             <ul style="list-style-type: none"> <li>➤ Steam</li> <li>➤ Diesel                                     <ul style="list-style-type: none"> <li>• Diesel Mechanical</li> <li>• Diesel Electric</li> <li>• Diesel Hydraulic</li> </ul> </li> <li>➤ Electric</li> <li>➤ Magnetic Levitation</li> </ul> </li> <li>▪ <b>According to use</b> <ul style="list-style-type: none"> <li>• Passenger</li> <li>• Freight</li> <li>• EMU</li> <li>• Switching/Shunting</li> <li>• Mining</li> </ul> </li> <li>▪ <b>According to Running Gear</b> <ul style="list-style-type: none"> <li>• Frame</li> <li>• Bogie</li> </ul> </li> </ul> </li></ul>	2	4	6
2.	Draw Locomotive and level parts.	<b>Parts of Locomotive:</b> <ul style="list-style-type: none"> <li>▪ Traction Power Arrangement</li> <li>▪ Transmission Equipment Arrangement</li> </ul>	2	4	6

S. N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
		<ul style="list-style-type: none"> <li>▪ Body and Frame</li> <li>▪ Bogie</li> <li>• Auxiliary Equipment</li> </ul>			
3.	List Locomotive Traction Characteristics	<p><b><u>Locomotive traction:</u></b></p> <ul style="list-style-type: none"> <li>▪ Locomotive Power</li> <li>▪ Traction Force</li> <li>▪ Resistance Force</li> <li>▪ Brake Force</li> </ul>	2	4	6
<b>Sub-total I</b>			<b>6</b>	<b>12</b>	<b>18</b>

### Module II: Internal Combustion Engine

S. N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
4.	Draw diagram of petrol/diesel engine	<p><b><u>Engine:</u></b></p> <ul style="list-style-type: none"> <li>▪ Definition</li> <li>▪ External Combustion Engine</li> <li>▪ Internal Combustion Engine <ul style="list-style-type: none"> <li>• Petrol Engine</li> <li>• Diesel Engine</li> </ul> </li> </ul>	2	3	5
5.	Classify Internal Combustion Engine	<p><b><u>Internal Combustion Engine:</u></b></p> <ul style="list-style-type: none"> <li>▪ Classification according to <ul style="list-style-type: none"> <li>• Number of cylinders</li> <li>• Arrangement of cylinder</li> <li>• Air Intake</li> <li>• Cooling type</li> <li>• Number of cycles</li> <li>• Fuel burned</li> <li>• Type of ignition</li> </ul> </li> </ul>	2	3	5
6.	Identify parts of Internal Combustion Engine	<p><b><u>Parts:</u></b></p> <ul style="list-style-type: none"> <li>▪ Engine body</li> <li>▪ Connecting rod</li> <li>▪ Valve gear</li> <li>▪ Fuel system</li> <li>▪ Lubricating system <ul style="list-style-type: none"> <li>• Ignition system</li> </ul> </li> </ul>	2	3	5
7.	State Working Principle of Internal Combustion Engine	<p><b><u>Combustion Engine:</u></b></p> <ul style="list-style-type: none"> <li>▪ <b>Working principle</b> <ul style="list-style-type: none"> <li>• Diesel engine</li> <li>• Petrol engine</li> </ul> </li> </ul>	1	3	4
8.	Assemble/Disassemble Diesel and Petrol Engine.	<ul style="list-style-type: none"> <li>▪ Diesel and petrol engine assembling and disassembling techniques</li> </ul>	1	35	36
<b>Sub-total II</b>			<b>8</b>	<b>47</b>	<b>55</b>

### Module III: Locomotive Bogie

S. N.	Task Statements	Related technical knowledge	Time (Hours)		
			T	P	Total
9.	Identify/ Draw Bogie	<p><b><u>Bogie:</u></b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Function of Bogie</li> <li>▪ How Bogie Works</li> <li>▪ Working Principle</li> <li>▪ Type</li> <li>▪ Wheel Arrangements</li> <li>▪ Articulated Bogie</li> <li>▪ Bogie Frame</li> <li>▪ Components of Bogie                             <ul style="list-style-type: none"> <li>• Wheel Set</li> <li>• Axle Box</li> <li>• Primary Suspension</li> <li>• Secondary Suspension</li> <li>• Damper</li> <li>• Bogie Frame</li> <li>• Leveling Valve</li> <li>• Anti-Rolling Bar</li> <li>• Anti-Yaw Damper</li> </ul> </li> </ul>	6	14	20
<b>Sub-total III</b>			<b>6</b>	<b>14</b>	<b>20</b>

### Module IV: Rolling Stocks

S. N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
10.	Classify/ identify rolling stocks  State working principle of Locomotives/ rolling stocks	<p><b><u>Locomotives and rolling stocks:</u></b></p> <ul style="list-style-type: none"> <li>▪ <b>Diesel/ Electrical Locomotive</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Working Principle</li> <li>• Types</li> </ul> </li> <li>▪ <b>Electric Multiple Unit (EMU)</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Working Principle</li> <li>• Types</li> </ul> </li> </ul>	3	9	12
11.	State the types of Wagons	<p><b><u>Wagons:</u></b></p> <ul style="list-style-type: none"> <li>▪ Passenger Wagons                             <ul style="list-style-type: none"> <li>• Semi-cushioned Seat Car</li> <li>• Semi-cushioned Berth Sleeping Car</li> <li>• Cushioned Berth Sleeping</li> </ul> </li> </ul>	2	9	11



S. N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
		Car <ul style="list-style-type: none"> <li>• Dining Car</li> <li>• Baggage Car</li> <li>• Mail Car</li> </ul> ▪ Freight Wagons <ul style="list-style-type: none"> <li>• Gondola</li> <li>• Box</li> <li>• Container</li> <li>• Hopper</li> <li>• Tank</li> </ul>			
12.	Classify rolling stock braking. State working principle of brakes. Install/adjust/repair braking system.	<b><u>Braking system:</u></b> <ul style="list-style-type: none"> <li>▪ Pneumatic brake</li> <li>▪ Electrodynamics brakes</li> <li>▪ Electro- Pneumatic brakes</li> <li>▪ Mechanical brakes</li> <li>▪ Electromagnetic brakes</li> </ul>	2	9	1
<b>Sub-total IV</b>			<b>7</b>	<b>27</b>	<b>34</b>

#### Module: V Locomotive Coupling Devices

S. N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
13.	Identify coupling device. Draw diagram of coupling devices.  State working principle of coupling device.  Install/adjust/repair coupling devices.	<b><u>Coupling devices:</u></b> <ul style="list-style-type: none"> <li>▪ Function</li> <li>▪ Types</li> <li>▪ Composition</li> <li>▪ Advantages</li> <li>▪ Disadvantages</li> <li>▪ Types and Working Principles</li> <li>▪ Coupler and Draft Gear</li> </ul>	3	10	13
<b>Sub-total V</b>			<b>3</b>	<b>10</b>	<b>13</b>
<b>Total (Sub-total I+ Sub-total II+ Sub-total III+ Sub-total IV+ Sub-total V)</b>			<b>30</b>	<b>110</b>	<b>140</b>

# Railway Electrification

**Total:** 210 hours  
**Theory:** 40 hours  
**Practical:** 170 hours

## Course Description

This course provides skills and knowledge related to Electro-Technology which is required for the setting up and operation of Railway Electrification that includes mainly Traction Sub-Station, Contact line System and Electric Traction Drive and Control.

## Course Objectives

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

1. Explain the scope and important of railway electrification systems;
2. Apply safety rules for electrical works;
3. Explain Electrical terms, constitution of matter, fundamental laws of electricity and electromagnetism;
4. Setup Traction Sub-Station;
5. Perform various Catenary wire installation;
6. Explain various Control techniques of Induction Motor; and
7. Carry out maintenance of railways electrical components.

## Module I: Basic Electricity

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
1.	Describe the concept of electricity.	<p><b><u>Concept of electricity:</u></b></p> <ul style="list-style-type: none"> <li>▪ Concept of the atom, ions &amp; matter</li> <li>▪ Atomic particles, atomic structure, free electrons</li> <li>▪ Charged body &amp; coulomb</li> <li>▪ Electric current and conventional flow</li> </ul> <p><b><u>Faraday's law of electromagnetic induction</u></b></p> <p><b><u>Electricity</u></b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Nature</li> <li>▪ Importance</li> <li>▪ History</li> <li>▪ sources</li> <li>▪ Uses</li> </ul>	2		2
2.	Identify/enumerate/handle tools and instruments.	<p><b><u>Tools and instruments:</u></b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Function</li> <li>▪ Types</li> <li>▪ Identification procedure</li> <li>▪ Uses</li> <li>▪ Care and maintenance</li> </ul>	1	4	5

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
3.	Identify /draw electrical symbols/ codes.	<p><b><u>Electrical drawing and wiring symbols:</u></b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Importance as technician's language</li> <li>▪ Use in electrical and electronics field</li> <li>▪ Orientation of symbols</li> <li>▪ Common wiring circuits</li> <li>▪ Single line representation of wiring diagrams</li> </ul>	1	2	3
4.	State the Ohm's law.	<p><b><u>Ohm's law:</u></b></p> <ul style="list-style-type: none"> <li>▪ Definition of current, voltage and resistance</li> <li>▪ Statement of Ohm's law</li> <li>▪ Relation among current, voltage and resistance</li> <li>▪ Measurement units of current, voltage and resistance</li> <li>▪ Mathematical expression as tools for circuit analysis</li> <li>▪ Current law using pie-shape chart</li> </ul>	1	3	4
5.	Calculate current/ voltage/ resistance.	<p><b><u>Concept of Current, Voltage &amp; Resistance:</u></b></p> <ul style="list-style-type: none"> <li>▪ Technique of solving the unknown values of current, voltage and resistance in the case of two of these values are given in the circuit parameters</li> </ul>	1	5	6
6.	Measure resistance-using Ohmmeter.	<p><b><u>Ohmmeter:</u></b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Operation</li> <li>▪ Connection diagram</li> <li>▪ Reading procedure</li> <li>▪ Safety precautions</li> </ul>	1	3	4
7.	Measure voltage using Voltmeters.	<p><b><u>Volt meter:</u></b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Operation</li> <li>▪ Connection Diagram</li> <li>▪ Reading Procedure</li> <li>▪ Safety precautions</li> </ul>	1	3	4
8.	Measure current using Ampere meter.	<p><b><u>Ampere meter:</u></b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Operation</li> <li>▪ Connection Diagram</li> <li>▪ Reading procedure</li> </ul>	1	3	4

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
		<ul style="list-style-type: none"> <li>▪ Safety precautions</li> </ul>			
9.	Verify Kirchhoff's Current (KCL) law.	<p><b><u>Kirchhoff's current law:</u></b></p> <ul style="list-style-type: none"> <li>▪ Statement of law</li> <li>▪ Mathematical expression</li> <li>▪ Circuit diagram</li> <li>▪ Verification table mentioning ammeter (<math>A_1</math>), ammeter (<math>A_2</math>), ammeter (<math>A_3</math>) and (<math>A_1 + A_2</math>) in amperes</li> </ul>	1	3	4
10.	Verify Kirchhoff's Voltage (KCV) law.	<p><b><u>Kirchhoff's voltage law:</u></b></p> <ul style="list-style-type: none"> <li>▪ Definition of closed loop</li> <li>▪ Statement of law</li> <li>▪ Mathematical expression</li> <li>▪ Circuit diagram or closed loop diagrams</li> <li>▪ Verification table mentioning one ammeter (<math>A_1</math>), three-volt meters <math>V_1</math>, <math>V_2</math> and <math>V_3</math> for reading voltages in the circuits and <math>V_1+V_2</math> voltage drops</li> </ul>	1	3	4
11.	Construct electric circuit for analysis.	<p><b><u>Electric circuit:</u></b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Types (series, parallel &amp; combined)</li> <li>▪ Circuit Diagram</li> <li>▪ Characteristic</li> <li>▪ Condition of circuit (open, closed, short, earth leakage)</li> <li>▪ Advantage &amp; disadvantage</li> </ul>	1	4	5
12.	Perform straight/ T/ Married joints of solid wire/ cable.	<p><b><u>Cable and joints:</u></b></p> <ul style="list-style-type: none"> <li>▪ Stranded cable <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Parts of cable</li> <li>• Advantage</li> <li>• Insulation removing technique</li> <li>• Types of Electrical Transmission cables (Power rating)</li> </ul> </li> <li>▪ <b>Joint</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> </ul> </li> <li>▪ <b>Straight/T / Married joints</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Measurement of joint</li> <li>• Uses</li> </ul> </li> </ul>	1	3	4

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
		<ul style="list-style-type: none"> <li>• Procedure</li> <li>• Safety precautions</li> </ul>			
13.	Make wire/cable eyelet.	<b><u>Cable eyelet:</u></b> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Measurement of joint</li> <li>▪ Terminations and Connectors</li> <li>▪ Uses</li> <li>▪ Procedure</li> <li>▪ Safety precautions</li> </ul>	1	3	4
14.	Interpret electrical drawings.	<b><u>Electrical drawing:</u></b> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Symbols</li> <li>▪ Identification of current capacity of accessories, fittings and protective devices</li> <li>▪ Interpretation technique</li> </ul>	1	3	4
15.	Draw free hand plan/schematic diagram.	<b><u>Free hand plan /schematic diagram:</u></b> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Importance</li> <li>▪ Types</li> <li>▪ Advantage</li> <li>▪ Uses</li> </ul>	1	3	4
16.	Draw layout diagram.	<b><u>Layout diagram:</u></b> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Importance</li> <li>▪ Types</li> <li>▪ Advantage</li> <li>▪ Uses</li> </ul>	1	3	4
17.	Draw wiring diagram.	<b><u>Wiring diagram:</u></b> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Importance</li> <li>▪ Types</li> <li>▪ Advantage</li> <li>▪ Uses</li> </ul>	1	3	4
18.	Install one lamp controlled from one point using T-connection and looping methods in wooden/plastic Listy.	<b><u>One lamp installation:</u></b> <ul style="list-style-type: none"> <li>▪ Methods of wiring</li> <li>▪ System of wiring</li> <li>▪ T-system connection</li> <li>▪ Loop system connection</li> <li>▪ Advantages&amp; disadvantage of loop in system</li> <li>▪ Types of diagrams</li> <li>▪ Wiring materials and accessories</li> <li>▪ Installation procedure</li> <li>▪ Testing of wiring installation</li> </ul>	1	6	7

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
		<ul style="list-style-type: none"> <li>▪ Safety precautions</li> </ul>			
19.	<p>Draw transformer equivalent circuit.</p> <p>Conduct transformer test.</p> <p>Operate autotransformer.</p>	<p><b><u>Magnetism and Electromagnetism:</u></b></p> <ul style="list-style-type: none"> <li>▪ Importance of magnetism in electricity</li> <li>▪ Magnetism terms- <ul style="list-style-type: none"> <li>• Magnetic poles</li> <li>• Magnetic axis</li> <li>• Magnetic field</li> <li>• Magnetic lines of force</li> <li>• Magnetic flux</li> <li>• Magnetic field strength</li> <li>• Properties of lines of force</li> </ul> </li> <li>▪ Diamagnetic, Paramagnetic, Ferromagnetic materials</li> <li>▪ Faraday's law of electromagnetic induction</li> <li>▪ Self and mutual inductance</li> <li>▪ Eddy current and Hysteresis loss</li> <li>▪ Transformer and auto-transformer</li> </ul>	2	18	20
20.	<p>Calculate:</p> <ul style="list-style-type: none"> <li>• Period, Cycle or frequency</li> <li>• Amplitude and Peak</li> <li>• Instantaneous and R.M.S. values</li> <li>• Form factor, in phase, out of phase</li> <li>• Inductance and inductive reactance</li> <li>• Capacitance and capacitive reactance</li> </ul>	<p><b><u>AC circuit:</u></b></p> <ul style="list-style-type: none"> <li>▪ Comparison between A.C. and D.C.</li> </ul> <p><b><u>Definition:</u></b></p> <ul style="list-style-type: none"> <li>▪ Period</li> <li>▪ Cycle or frequency</li> <li>▪ Amplitude</li> <li>▪ Peak</li> <li>▪ Instantaneous and R.M.S. values</li> <li>▪ Form factor</li> <li>▪ Peak factor in phase &amp; out of phase</li> <li>▪ Inductance and inductive reactance,</li> <li>▪ Capacitance</li> <li>▪ Capacitive reactance</li> <li>▪ Impedance</li> <li>▪ Cause of low power factor in industrial areas and its improvement</li> <li>▪ Difference between Single and three phase circuits</li> </ul>	2	6	8
21.	Acquaint with Sources of Electrical power.	<b><u>Sources of electrical energy in Nepal:</u></b>	2	1	3

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
	Apply prevailing Electricity rules and regulations.	<ul style="list-style-type: none"> <li>▪ Solar and wind power station</li> <li>▪ Hydroelectric power station</li> <li>▪ Diesel and thermal power station etc.</li> <li>▪ Power development of Nepal</li> <li>▪ Total Power Generation of Nepal</li> </ul> <p><b><u>Electricity rules and regulation:</u></b></p> <ul style="list-style-type: none"> <li>▪ Concept of electrical energy development in Nepal</li> <li>▪ Rules for – consumer, standard voltage for distribution</li> <li>▪ Concept of NEA code of practice</li> </ul>			
<b>Sub-total I</b>			<b>25</b>	<b>82</b>	<b>107</b>

#### Module II: Traction Sub-Station

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
22.	Draw single line diagram of traction Sub-station.	<p><b><u>Traction sub-station:</u></b></p> <ul style="list-style-type: none"> <li>▪ Difference between AC and DC traction system</li> <li>▪ Single phase and Three phase traction substation,</li> <li>▪ Three-phase to two-phase balance transformer substation connection</li> </ul>	4	20	24
<b>Sub-total II</b>			<b>4</b>	<b>20</b>	<b>24</b>

#### Module III: Railway Contact Line System

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
23.	Install catenary mast.  Install Overhead Line.	<p><b><u>Transmission system:</u></b></p> <ul style="list-style-type: none"> <li>▪ Basic Concept of AC and DC Transmission</li> <li>▪ Concept of tower, pole, hardware and Insulators</li> <li>▪ Two phase system, balancing, messenger wire and feeder wire, Tensioning, staggering, neutral section, pantograph principle, Safety Consideration, DC System and stray current</li> <li>▪ Overhead line installation plan for different track geometry, Overhead line</li> </ul>	3	10	13

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
		Equipment with cantilever mast and portal frames, <ul style="list-style-type: none"> <li>▪ Catenary installation machines and working process</li> <li>▪ Procedure</li> <li>▪ Safety precautions</li> </ul>			
<b>Sub-total III</b>			<b>3</b>	<b>10</b>	<b>13</b>

#### Module IV: Traction Motor Drive

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
24.	Draw the electrical Motor circuit.  Conduct motor performance test.	<b><u>D.C and A.C. motors:</u></b> <ul style="list-style-type: none"> <li>▪ Definition, construction, working principles</li> <li>▪ Single phase / Three phase motors</li> <li>▪ Split phase motor</li> <li>▪ Synchronous motors</li> <li>▪ Capacitor start capacitor run motors</li> <li>▪ Universal and shaded pole motors</li> <li>▪ Permanent capacitor motors</li> <li>▪ Principle of induction motor</li> <li>▪ Capacitor start induction motor</li> <li>▪ Torque formula</li> <li>▪ Motor speed and slip</li> <li>▪ Procedure</li> <li>▪ Safety precautions</li> </ul>	3	25	28
25.	Perform/Test various parameters (Constant torque mode, Constant power mode, Balancing speed range etc.) to control AC induction motor drive in traction application Draw the performance curve.  Determine optimum point of operation.	<b><u>Induction Motor drive control technique:</u></b> <ul style="list-style-type: none"> <li>▪ Basic of Power Electronic</li> <li>▪ AC Electric Traction Drives</li> <li>▪ Various Technique to control Induction Traction Motor</li> <li>▪ Starting, Braking and Speed control of traction motors</li> <li>▪ Procedure</li> <li>▪ Safety precautions</li> </ul>	2	12	14
<b>Sub-total IV</b>			<b>5</b>	<b>37</b>	<b>42</b>

#### Module V: Maintenance of Electrical Components

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
26.	Identify maintenance Tool/instruments/equipment.	<b><u>Maintenance tools, instruments and equipment:</u></b> <ul style="list-style-type: none"> <li>▪ Electrical components maintenance tools, instruments and equipment</li> </ul>	1	3	4



S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
		Infrared Thermal Imaging Camera, power quality analyzer, leakage current tester, auto ranging digital multimeter, digital Megger, Crimping tool, stripping tool, wire cutter, combination plier, electric solder iron, de-soldering gun, hot air gun, portable blower, insulating tapes, battery analyzer, winding insulation resistance meter, fuse puller <ul style="list-style-type: none"> <li>▪ Function, identification</li> <li>▪ Safety precautions</li> </ul>			
27.	Test/Repair/replace Electrical Components (Batteries, UPS, Induction motor, Traction drive, Generator, Sub-Station Components, Circuit Breaker, Negative return Switch, DC traction circuit breaker, Transformer and Motor windings, hot development on loose connection, Power quality problem in three- and single-phase power distribution system, cables, bulbs, switch, air-conditioner, fuse, current, voltage, resistance, frequency, solar panel output, solar cell voltage).	<b><u>Electrical components maintenance:</u></b> <ul style="list-style-type: none"> <li>▪ Concept of periodic, preventive and condition-based maintenance</li> <li>▪ Electrical components               <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types</li> <li>• Identification</li> </ul> </li> <li>▪ Testing tools, instruments and equipment</li> <li>▪ Testing procedure</li> <li>▪ Maintenance procedure</li> <li>▪ Safety precautions</li> </ul>	2	18	20
		<b>Sub-total V</b>	<b>3</b>	<b>21</b>	<b>24</b>
<b>Total (Sub-total I+ Sub-total II+ Sub-total III + Sub-total IV+ Sub-total V)</b>			<b>40</b>	<b>170</b>	<b>210</b>

### References

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- Installation Servicing and Maintenance – S.N. Bhattacharya
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- Basic electrical engineering volume I and II – P.S. Dhogal
- Kiessling, Puschmann, Schmieder, Schneider, “Contact Lines for Electric Railways”, Publicis Publish, 2009
- NEA Rules and Standards
- Bimal K. Bose. “Modern Power Electronics and AC Drives”. Beijing: China machinery Press, 2003

## Entrepreneurship Development

**Total:** 78 hours  
**Theory:** 30 hours  
**Practical:** 48 hours

### Course Description:

This course is designed to impart knowledge and the skills on formulating business plan and managing small business in general. This course intends to deal with exploring, acquiring and developing enterprising tasks, identification of suitable business idea and developing of business plan.

### Course Objectives:

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

1. Define business and entrepreneurship;
2. Explore entrepreneurial tasks;
3. Analyze business ideas and viability;
4. Formulate business plan; and
5. Learn to manage small business.

### Module I: Introduction to Entrepreneurship

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
1.	Introduce business	<u><b>Business:</b></u> <ul style="list-style-type: none"> <li>▪ Definition of business/enterprise</li> <li>▪ Types of business</li> <li>▪ Classification of business</li> <li>▪ Overview of MSMEs (Micro, Small and Medium Enterprises) in Nepal</li> </ul>	1.5		1.5
2.	Define entrepreneur/ entrepreneurship	<u><b>Entrepreneur:</b></u> <ul style="list-style-type: none"> <li>▪ Definition of entrepreneur</li> <li>▪ Definition of entrepreneurship</li> <li>▪ Entrepreneurship development process</li> </ul>	0.5	0.5	1.0
3.	Describe entrepreneur's characteristics.	<u><b>Entrepreneur's characteristics:</b></u> <ul style="list-style-type: none"> <li>▪ Characteristics of entrepreneurs</li> <li>▪ Nature of entrepreneurs</li> </ul>	0.67	0.83	1.5
4.	Assess entrepreneur's characteristics.	<u><b>Assessment of entrepreneur's characteristics:</b></u> <ul style="list-style-type: none"> <li>▪ List of human characteristics</li> <li>▪ Assessment of entrepreneurial characteristics</li> </ul>	0.5	1.0	1.5
5.	Compare entrepreneur with other occupations.	<u><b>Entrepreneur and other occupations:</b></u> <ul style="list-style-type: none"> <li>▪ Comparison of entrepreneur with other occupations</li> <li>▪ Types and styles of entrepreneurs</li> </ul>	1.0		1.0

S.N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
6.	Differentiate between entrepreneur and employee.	<u><b>Entrepreneur and employee:</b></u> <ul style="list-style-type: none"> <li>▪ Difference between entrepreneur and employee</li> <li>▪ Benefit of doing own business</li> </ul>	0.5	0.5	1.0
7.	Assess “Self.”	<u><b>Self-assessment:</b></u> <ul style="list-style-type: none"> <li>▪ Understanding “self”</li> <li>▪ Self-disclosure and feedback taking</li> </ul>	0.6	0.4	1.0
8.	Assess “Self” inclination to business.	<u><b>Entrepreneurial personality test:</b></u> <ul style="list-style-type: none"> <li>▪ Concept of entrepreneurial personality test</li> <li>▪ Assessing self-entrepreneurial inclination</li> </ul>	0.67	0.83	1.5
<b>Sub-total I</b>			<b>5.75</b>	<b>4.08</b>	<b>9.83</b>

### Module II: Creativity and Assessment

S. N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
9.	Create viable business idea.	<u><b>Creativity:</b></u> <ul style="list-style-type: none"> <li>▪ Concept of creativity</li> <li>▪ Barriers to creative thinking</li> </ul>	1.67	0.33	2.0
10.	Innovate business idea.	<u><b>Innovation:</b></u> <ul style="list-style-type: none"> <li>▪ Concept of innovation</li> <li>▪ SCAMPER Method of innovation</li> </ul>	0.83	0.67	1.5
11.	Transfer ideas into action.	<u><b>Transformation of idea into action:</b></u> <ul style="list-style-type: none"> <li>▪ Concept of transferring idea into action</li> <li>▪ Self-assessment of creative style</li> </ul>	1.0	0.5	1.5
12.	Assess personal entrepreneurial tasks.	<u><b>Personal entrepreneurial tasks:</b></u> <ul style="list-style-type: none"> <li>▪ Concept of entrepreneurial tasks</li> <li>▪ Assessing personal entrepreneurial tasks</li> </ul>	0.5	1.0	1.5
13.	Assess personal risk-taking attitude.	<u><b>Risk taking attitude:</b></u> <ul style="list-style-type: none"> <li>▪ Concept of risk</li> <li>▪ Personal risk-taking attitude</li> <li>▪ Do and don't do while taking risk</li> </ul>	1.5	1.0	2.5
14.	Make decision.	<u><b>Decision making:</b></u> <ul style="list-style-type: none"> <li>▪ Concept of decision making</li> <li>▪ Personal decision-making attitude</li> <li>▪ Do and don't do while making decision</li> </ul>	1.0	0.5	1.5
<b>Sub-total II</b>			<b>6.5</b>	<b>4.0</b>	<b>10.5</b>

### Module III: Identification and Selection of Viable Business Ideas

S. N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
15.	Identify/ select potential business idea.  Analyze strength, Weakness, Opportunity and Threat (SWOT) of business idea.	<b><u>Identification and selection of potential business:</u></b> <ul style="list-style-type: none"> <li>▪ Sources of business ideas</li> <li>▪ Points to be considered while selecting business idea</li> <li>▪ Business selection process</li> <li>▪ Potential business selection among different businesses</li> <li>▪ Strength, Weakness, Opportunity and Threats (SWOT) analysis of business idea</li> <li>▪ Selection of viable business idea matching to “self”</li> </ul>	0.83	3.42	4.25
<b>Sub-total III</b>			<b>0.83</b>	<b>3.42</b>	<b>4.25</b>

### Module IV: Business Plan

S. N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
16.	Assess market and marketing	<b><u>Market and marketing:</u></b> <ul style="list-style-type: none"> <li>▪ Concept of market and marketing</li> <li>▪ Marketing and selling</li> <li>▪ Market forces</li> <li>▪ 4 Ps of marketing</li> <li>▪ Marketing strategies</li> </ul>	1.33	0.75	2.08
17.	Explore small business management concept.	<b><u>Business exercise:</u></b> <ul style="list-style-type: none"> <li>▪ Business exercise rules</li> <li>▪ Concept of small business management</li> <li>▪ Elements of business management               <ul style="list-style-type: none"> <li>• Planning</li> <li>• Organizing</li> <li>• Executing</li> </ul> </li> <li>▪ Controlling</li> </ul>	1.58	1.67	3.25
18.	Prepare market plan.	<b><u>Business plan/Market plan</u></b> <ul style="list-style-type: none"> <li>▪ Concept of business plan</li> <li>▪ Concept of market plan</li> <li>▪ Steps of market plan</li> </ul>	2.0	2.0	4.0
19.	Prepare production plan.	<b><u>Business plan/Production plan:</u></b> <ul style="list-style-type: none"> <li>▪ Concept of production plan</li> <li>▪ Steps of production plan</li> </ul>	1.25	1.5	2.75
20.	Prepare business operation plan.	<b><u>Business plan/ Business operation plan:</u></b> <ul style="list-style-type: none"> <li>▪ Concept of business operation plan</li> <li>▪ Steps of business operation plan</li> </ul>	2.5	2.67	5.17

S. N.	Task Statements	Related Technical Knowledge	Time (Hours)		
			T	P	Total
		<ul style="list-style-type: none"> <li>▪ Cost price determination</li> </ul>			
21.	Prepare financial plan.	<p><b><u>Business plan/Financial plan:</u></b></p> <ul style="list-style-type: none"> <li>▪ Concept of financial plan</li> <li>▪ Steps of financial plan</li> <li>▪ Working capital estimation</li> <li>▪ Pricing strategy</li> <li>▪ Profit/loss calculation</li> <li>▪ BEP and ROI analysis</li> <li>▪ Cash flow calculation</li> </ul>	4.5	7.5	12.0
22.	Collect market information /prepare business plan.	<p><b><u>Information collection and preparing business plan:</u></b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Market survey <ul style="list-style-type: none"> <li>• Precaution to be taken while collecting information</li> <li>• Sample questions for market survey</li> <li>• Questions to be asked to the customers</li> <li>• Questions to be asked to the retailer</li> <li>• Questions to be asked to the stockiest/suppliers</li> <li>• Preparing business plan</li> </ul> </li> </ul>	2.0	13.0	15.0
23.	Appraise business plan.	<p><b><u>Business plan appraisal:</u></b></p> <ul style="list-style-type: none"> <li>▪ Return on investment</li> <li>▪ Breakeven analysis</li> <li>▪ Cash flow</li> <li>▪ Risk factors</li> </ul>	0.5	5.5	6.0
24.	Maintain basic bookkeeping.	<p><b><u>Basic book keeping:</u></b></p> <ul style="list-style-type: none"> <li>▪ Concept and need of book keeping</li> <li>▪ Methods and types of book keeping</li> <li>▪ Keeping and maintaining of day book and sales records</li> </ul>	1.0	2.0	3.0
		<b>Sub-total IV</b>	<b>16.67</b>	<b>36.58</b>	<b>53.25</b>
		<b>Total (Sub-total I+ Sub-total II+ Sub-total III+ Sub-total IV)</b>	<b>30</b>	<b>48</b>	<b>78</b>

## **On-the-Job Training (OJT)**

**Full Marks: 300**

**Practical: 12 weeks/480 hrs.**

### **Program Description**

On-the Job Training (OJT) is an integrated part of this curricular program since the OJT is a hands-on method of imparting the vital knowledge, skills, and competencies within the workplace. It is designed to provide many opportunities to students for meaningful career related experiences by working fulltime in real organizational settings where they can practice and apply institute based; their learned knowledge and skills. It enables them to level up their technical skills, knowledge, and attitudes towards their works. The OJT will implement for the period of three months before graduation. It also helps students to gain a clearer sense of what they still need to learn and provide many opportunities to build professional networks.

The students will be eligible for OJT only after completing final examination. The institute will make necessary arrangement for OJT placement. The related institute will inform the CTEVT at least one month prior to the OJT placement date along with plan, schedule, the name of the students and their corresponding OJT placement institutions.

### **Program Objectives**

The main objective of On-the-Job Training (OJT) program is to provide hands on practice platforms to experience the real world of works. However, the general objectives of the OJT practice program are to:

1. Ensure quality training and proper skills, work attitude and knowledge of students;
2. Apply acquired knowledge, skills and attitude in problem-based exercises in real life industrial projects;
3. Provide occupational tasks learning platforms in the form of work-based learning;
4. Make students familiar with the future occupation/ job platforms;
5. Provide platforms for learning and experiencing professional, organizational, team building, analytical and personal life skills;
6. Make students familiar with the day to day administrative / management activities applicable in their related occupation;
7. Establish the strong linkage between industries and institutes;
8. Match the occupational skills learned at the institute with the needs of the employer;
9. Provide opportunity for students to acquire interpersonal skills and ability for team work through interaction with professionals in their field of study;
10. Enhance employability, adoptability, confidentiality, independency and social and emotional intelligence;
11. Provide an opportunity for students to learn about the industry of their discipline and related environment;
12. Provide an opportunity for the industry to identify potential employees and to feedback comments on the pre-diploma program at large;
13. Provide opportunity to obtain knowledge and skills on of how to make optimal decisions to resolve work challenges;
14. Earn ethics in the industries;
15. Learn accepted safety practices in the industries;
16. Increase better chances for career mobility;
17. Ensure better employment opportunities for its graduates.

## Learning Outcomes

After completion of OJT, students will be able to:

1. Extend the boundaries of knowledge and skills through work-place practice;
2. Develop significant commitment in the' profession/ specialization;
3. Integrate classroom theory and practical skills with workplace learning;
4. Develop greater clarity about academic and career goals;
5. Develop new or advanced skills;
6. Develop lifelong learning skills;
7. Gain understanding of administrative functions and organization culture;
8. Appreciate the ethical basis of professional practice in relevant industry;
9. Display a capacity for critical reasoning and independent learning;
10. Write formatted report explaining the work in industrial practice and describing the experience;
11. Assess the adequacy of work place practice;
12. Explore options in career plans and goals; and
13. Make a gradual transition from academia to career.

## Duration

3 months (12 weeks/72 working days/480 hours)

## Activities

In this program, the students will place in the real world of work under the direct supervision of supervisor of related organization. The students will involve in design, construction, operation and maintenance work of railway transportation systems as per the rules and regulations of the organizations.

## Potential OJT Placement Sites

The nature of work in OJT is practical and potential OJT placement site should be as follows;

- Railway design, construction, operation and maintenance organizations

## Requirements for Successful Completion of On-the-Job Training

For the successful completion of the OJT, the students should;

- submit daily attendance record approved by the concerned supervisor and minimum 72 working days attendance is required
- maintain daily diary with detail activities performed in OJT and submit it with supervisor's signature
- prepare and submit comprehensive final OJT completion report with attendance record and diary
- secure minimum of 60% marks in each evaluation

## Complete OJT Plan

S.N.	Activities	Duration	Remarks
1	Orientation	2 days	Before OJT placement
2	Communicate to the OJT site	1 day	Before OJT placement
3	Actual work at the OJT site	12 weeks/480 hours	During OJT period

S.N.	Activities	Duration	Remarks
4	First-term evaluation	one week (for all sites)	After 5 to 6 weeks of OJT commenced date
5	Mid-term evaluation	one week (for all sites)	After 9 to 10 weeks of OJT commenced date
6	Report to the parental organization	1 day	After OJT placement
7	Final report preparation	5 days	After OJT completion

- The institute should conduct first and mid-term evaluation.
- After completion of 3 months OJT period, students will be provided with one-week period to review all the works and prepare a comprehensive final report.
- Evaluation will be made according to the marks at the following evaluation scheme but first and mid-term evaluation record will be considered.

### Evaluation Scheme

Evaluation and mark distribution are as follows:

S.N.	Activities	Who/Responsibility	Marks
1	OJT Evaluation (should be three evaluation in three months –one evaluation in each month)	Supervisor of OJT provider	200
2	First and mid- term evaluation	The Training Institute	100
	<b>Total</b>		<b>300</b>

### Important

- Students must score 60 percent marks in each evaluation for the successful completion of the OJT
- If OJT placement allocate in more than one institution, separate evaluation is required from all institutions.

### OJT Monitoring and Evaluation

- CTEVT and/or Regional office and/or technical school will conduct the monitoring of OJT at any time during the OJT period.
- CTEVT, Controller of Examination will provide OJT implementation guideline along with detail OJT evaluation criteria and marks distribution



## **Experts involved**

- Aman Chitrakar, Senior Divisional Engineer, Department of Railways, Bishalnagar
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- Bodh Prasad Bhandari, Engineer, Department of Railways, Bishalnagar
- Rabindra shah, Engineer, Office of Railways, Janakpurdham, Dhanusha
- Paribesh Parajuli, Railways Engineer/Principal, Mahanagar Polytechnic Institute, Biratnagar
- Santa Kumar Maharjan, Radio Engineer, Centre for Education and Human Resource Development, Sanothimi, Bhaktapur
- Kiran Karki, Engineer, Department of Road, Khurkot Division, Sindhuli
- Kapil Dev Acharya, Deputy Secretary General, Nepal Engineers' Association
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