GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM
COURSE TITLE: ELECTRIC TRACTION AND CONTROL
(COURSE CODE: 3350907)

Diploma Programme in which this course is offered	Semester in which offered
Electrical Engineering	5th Semester

1. RATIONALE

The country is leading towards the railway electrification and also moving towards metro, monorail system. The diploma student is required to know about the electric traction scheme and its latest trends. This subject is offered as one of the elective, highlighting the current and future trends in traction systems, auxiliary equipment, electric locomotives, control of traction motors and future-trends. The Diploma pass student with this elective will be able to maintain the traction systems, auxiliary equipment, electric locomotives and traction motors.

2. LIST OF COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency:

- **Maintain traction systems, auxiliary equipment, electric locomotives and traction motors.**

3. COURSE OUTCOMES

The theory should be taught and practical should be undertaken in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domains to demonstrate the following course outcomes:

i. Distinguish different traction systems and latest trends in traction systems.
ii. Differentiate services of traction system based on speed time curve.
iii. Control different types of traction motors
iv. Use various traction system auxiliaries.
v. Explain the distribution system of a traction system.

vi. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
3	0	2	5	70	30	20	30	150

Legends: L-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **ESE** - End Semester Examination; **PA** - Progressive Assessment.

4. COURSE DETAILS

Unit	Major Learning Outcomes (Major outcomes in cognitive domain)	Topics and Sub-topics
UNIT – I Traction Systems and Latest Trends	1a. Explain the present scenario of Indian Railways- High speed traction, Metro 1b. Detail the latest trends in traction. 1c. Explain types of traction systems and their significance. 1d. Explain the general arrangement of different types of Electric traction systems and their significance. 1e. Select a traction system for a given application.	1.1 Present scenario of Indian Railways – High speed traction, Metro 1.2 Latest trends in traction- Metro, monorail, Magnetic levitation Vehicle 1.3 Steam, diesel, diesel-electric, Battery and electric traction systems 1.4 General arrangement of D.C.,A.C.singlephase,3phase hase,Composite systems 1.5 Choice of traction system - Diesel- Electric or Electric
UNIT– II Mechanics of Train Movement	2a. Draw the speed time curve related to different traction system. 2b. Solve numerical based on speed time curve. 2c. Calculate specific energy consumption. 2d. State the factors affecting Specific energy consumption.	2.1 Analysis of speed time curves for main line, suburban and urban services 2.2 Simplified speed time curves. 2.3 Relationship between principal quantities in speed time curves 2.4 Requirement of tractive effort 2.5 Specific energy consumption and Factors affecting it.
UNIT– III Traction Motors and Their Control	3a. State the desirable features of traction motors. 3b. Explain Significance of D.C. series motor over D.C. Shunt motor. 3c. Explain working of various A.C. motors as traction motors. 3d. Compare different traction motors. 3e. Apply various control methods applied to traction motors. 3f. Explain different types of electric braking system.	3.1 Features of traction motors. 3.2 Significance of D.C. series motor as traction motor 3.3 A. C. Traction motors-single phase, Three phase, Linear Induction Motor 3.4 Comparison between different traction motors 3.5 Series-parallel control 3.6 Open circuit, Shunt and bridge transition 3.7 Pulse Width Modulation control of induction motors 3.8 Types of electric braking system.

Unit	Major Learning Outcomes (Major outcomes in cognitive domain)	Topics and Sub-topics
UNIT-IV Electric Locomotives and Auxiliary Equipment	4a. Classify electric locomotive 4b. Describe the function of auxiliaries in traction system 4c. Describe the different current collecting methods in locomotives 4d. Explain different control and auxiliary equipment used in the locomotive 4e. Describe the Power conversion and transmission systems 4f. Explain Coach wiring and lighting devices	4.1 Important features of electric locomotives 4.2 Different types of locomotives 4.3 Current collecting equipment 4.4 Coach wiring and lighting devices 4.5 Power conversion and transmission systems 4.6 Control and auxiliary equipment.
UNIT-V Feeding and Distribution System.	5a. Explain the distribution & feeder system pertaining to traction 5b. Classify traction substations 5c. Describe different methods of feeding the traction sub- station	5.1 Distribution systems pertaining to traction (distributions and feeders) 5.2 Traction sub-station requirements and selection 5.3 Method of feeding the traction sub- station

5. SUGGESTED SPECIFICATION TABLE WITH HOURS and MARKS (THEORY)

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Traction Systems and Latest Trends	04	04	04	00	08
II	Mechanics of Train Movement	07	04	05	05	14
III	Traction Motors and Their Control	15	05	07	10	22
IV	Electric Locomotives and Auxiliary Equipment	12	06	06	06	18
V	Feeding and Distribution System	04	02	02	04	08
	Total	**42**	**21**	**24**	**25**	**70**

Legends: R = Remembrance; U = Understanding; A = Application and above levels (Revised Bloom's taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

6. SUGGESTED LIST OF EXERCISES/PRACTICALS

The tutorial/practical/exercises should be properly designed and implemented with an attempt to develop different types of cognitive and practical skills**(Outcomes in cognitive, psychomotor and affective domain)** so that students are able to acquire the competencies.

Note*: Here only outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development*

*of **Programme Outcomes/Course Outcomes in affective domain** as given in a common list at the beginning of curriculum document for this programme. Faculty should refer to that common list and should ensure that students also acquire those Programme Outcomes/Course Outcomes related to affective domain*

S. No.	Unit No.	Practical Exercises (Major outcomes in Psychomotor Domain)	Approx Hours. required
1	I	Investigate the various traction systems in Indian railways.	2
2	I	Investigate various latest trends in electric traction systems.	2
3	II	Solve numericals on speed time curves.	2
4	II	Solve numericals on specific energy consumption.	2
5	III	Calculate energy saving by series parallel control of D. C. Motor (for two and four motors).	2
6	III	Justify the use of D. C. Series motor as traction motor.	2
7	III	Investigate the energy recovered using regenerative braking.	2
8	IV	Describe the train lighting system.	2
9	IV	Draw sketch of the current collecting equipments.	2
10	IV	Study of layout of D. C. locomotive and diesel locomotive.	2
11	1V	Study of power diagram of A.C. locomotive and its equipment.	2
12	V	Study of major equipments in AC traction substations.	2
13	VI	Use electronic control of traction motor.	2
14	VI	Understand the working of high speed train.	2
		Total Hours	**28**

7. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities like:

i. Prepare a report on current collector of bow and pantograph type current collector, showing complete arrangements of Pantograph its location and electric wiring system with locomotive.

ii. Prepare a report on the following locomotives:
   a. D. C. locomotive
   b. A. C. / D. C. locomotive
   c. Diesel electric locomotive (Report to be written)

iii. Prepare a report after visiting a electric-traction substation

8. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

i. Arrange visit to nearby locomotive workshops.

ii. Show video/animation films to explain functioning of traction motor.

iii. Have Group Discussion on various topics and get updated with latest trends in traction.

9. SUGGESTED LEARNING RESOURCES

A) List of Books

S. No.	Title of Book	Author	Publication
1.	Modern Electric Traction	H. Partab	Dhanpat Rai and Sons, New Delhi
2.	Electric Traction	J. Upadhyay S. N. Mahendra	Allied Publishers Ltd., Dhanpat Rai and Sons, New Delhi
3.	Electric Traction	A.T. Dover	Mac millan, Dhanpat Rai and Sons, New Delhi
4.	Electric Traction Hand Book	R. B. Brooks.	Sir Isaac Pitman and sons ltd. London.

B) List of Major Equipment/ Instrument with Broad Specifications

i. Models of different traction systems and equipment

C) List of Software/Learning Websites

i. www.irieen.com (Indian Railways Institute of Electrical Engineering, Nasik Road)
ii. www.wr.railnet.gov.in/bctweb/ELECTRICAL.htm
iii. www.scrailway.gov.in

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- **Prof. A. A. AMIN**, Lecturer Electrical Engineering, Government Polytechnic, Vadnagar.
- **Prof.V. R. KOTDAWALA**,Lecturer Electrical Engineering, Government Polytechnic, Himmatnagar.
- **Prof. N. N. PANDYA,** Lecturer, Electrical Engineering, Government Polytechnic, Ahmedabad.
- **Prof .S. V. JAGANI ,** Lecturer, Electrical Engineering, Government Polytechnic, Dahod.

Coordinator and Faculty Members from NITTTR Bhopal

- **Dr (Mrs.) C. S. Rajeshwari,** Professor and Head, Department of Electrical and Electronics Engineering.
- **Dr J. Earnest,** Professor and Head, Department of Electrical and Electronics Engineering,