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. It is a need for the diploma student to know about the electric traction scheme as it is an open field of job opportunity. The subject is classified as elective course, with a view to give exhaustive coverage to electric traction along with the environmental impact as well as bulk transportation boost. The content gives the better coverage of subject in traction systems, auxiliary equipment, electric locomotives, control of traction motors and future-trends.

2. 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 carried out in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

i. Identify different traction systems.
ii. Differentiate speed time curve of different services of traction system.
iii. Use traction system auxiliaries.
iv. Calculate energy consumption of traction system.
v. Use various speed control methods applicable to traction motors.
vi. Get exposure with modern trends in traction.

4. 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

5. COURSE DETAILS

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I. TRACTION SYSTEMS.	1a. Explain different types of traction systems and their significance. 1b. Explain different types of Electric traction systems (with general arrangements)and their significance.	1.1 Steam, diesel, diesel-electric, Battery and electric traction systems. 1.2 General arrangement of D.C., A.C. - 1-phase,3-phase,Composite systems. 1.3 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. List 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. 2.4Requirement of tractive effort. 2.5Specific energy consumption & Factors affecting it. 2.6Numerical examples.
Unit– III TRACTION MOTORS AND THEIR CONTROL.	3a. List 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. 3.2Significance 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. 3.6 Series-parallel control. 3.7 Open circuit ,Shunt and bridge transition. 3.8 PWM control of induction motors. 3.9 different types of electric braking system.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit-IV ELECTRIC LOCOMOTIVES &AUXILIARY EQUIPMENT.	4a. General classification of locomotive. 4b. Explain the function of auxiliaries in traction system. 4c. Explain different current collecting methods in locomotives. 4d. Explain different control and auxiliary equipment used in the locomotive.	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 types and working of distribution system. 5b.Classify traction substations. 5c. Explain 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.
Unit-VI FUTURE TRENDS IN TRACTION.	6a. Get acquainted with the modern trend applied in traction. 6b.Explain the present scenario of Indian railways at present.	6.1 Energy conservation in Electric traction. 6.2 Indian present scenario in electric traction.-Metro 6.3 Magnetic levitation - Levitation Schemes. - Present Scenario 6.4 High speed traction.

6. 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.**	02	02	02	00	04
II	**MECHANICS OF TRAIN MOVEMENT.**	07	04	05	05	14
III	**TRACTION MOTORS AND THEIR CONTROL.**	15	05	07	10	22
IV	**ELECTRIC LOCOMOTIVES & AUXILIARY EQUIPMENT.**	12	06	06	06	18
V	**FEEDING AND DISTRIBUTION SYSTEM.**	04	02	02	04	08
VI	**FUTURE TRENDS IN TRACTION.**	02	02	02	00	04
	Total	**42**	**21**	**24**	**25**	**70**

Legends: R = Remember U = Understand; A = Apply and above levels (Bloom's revised 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.

7. SUGGESTED LIST OF EXERCISES/PRACTICALS

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills **(outcomes in psychomotor and affective domain)** so that students are able to acquire the competencies/programme outcomes. Following is the list of practical exercises for guidance.

***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 certain outcomes in affective domain which would in turn lead to development of **Course Outcomes** related to affective domain. Thus over all development of **Programme Outcomes (**as given in a common list at the beginning of curriculum document for this programme) would be assured.*

Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.

S. No.	Unit No.	Practical Exercises (outcomes in Psychomotor Domain)	Approx Hours. required
1	I	Study of various traction systems.	2
2	I	Study various types of electric traction systems.	2
3	II	Tutorials on speed time curves.	2
4	II	Tutorials 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	Study of energy recovered using regenerative braking.	2
8	IV	Study of train lighting system.	2
9	IV	Study of 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 of electronic control of traction motor.	2
14	VI	Understand the working of high speed train.	2
		Total Hours	**28**

8. SUGGESTED LIST OF STUDENT ACTIVITIES

VISITS:

1. Study of bow and pantograph type current collector, showing complete arrangements of Pantograph its location and electric wiring system with locomotive. (Report to be written)
2. Study of following types of locomotive:
(i) D. C. locomotive
(ii) A. C. / D. C. locomotive
(iii) Diesel electric locomotive (Report to be written)
3. Study of electric-traction substation.

SPECIAL INSTRUCTIONAL STRATEGIES (if any)

(i) Arrange visit to nearby locomotive.
(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 & Sons
2.	Electric Traction	J. Upadhyay S. N. Mahendra	Allied Publishers Ltd.
3.	Electric Traction	A.T. Dover	Mac millan.
4.	Electric Traction Hand Book	R. B. Brooks.	Sir Isaac Pitman & sons ltd. London.

B) List of Software/Learning Websites

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

10. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

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

Coordinator and Faculty Members from NITTTR Bhopal