GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering
Level: Diploma
Branch: Automobile Engineering
Subject Code: DI05002061
Subject Name: Tractor and Farm Equipment

w. e. f. Academic Year:	2026-27
Semester:	5th
Category of the Course:	PEC-4

Prerequisite:	----
Rationale:	Farm mechanization is essential for improving agricultural productivity and reducing human labor. Tractors and farm equipment play a key role in modern farming operations. This course provides basic knowledge of the construction, working principles, operation, and maintenance of tractors and commonly used farm implements. It helps understand the selection, efficient use, and safe handling of farm machinery. Recent developments and future scope discussed make the course suitable for preparing diploma engineering students for employment in agricultural machinery industries, service and maintenance sectors, and self-employment, thereby supporting rural development and sustainable agriculture.

Course Outcome:
After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Explain the history, evolution, definitions, functions, and classification of tractors, and compare tractors with road automobiles.	R & U
02	Describe the construction, layout, engines, transmission, steering, braking, and control systems used in modern tractors.	R & U
03	Analyze tractor hydraulic systems, hitching mechanisms, PTO systems, ballast requirements, and their interaction with farm implements.	U & A
04	Demonstrate proper tractor operation, maintenance practices, implement upkeep, and apply essential safety principles during field and road use.	U & A
05	Assess recent technological developments and evaluate future trends in tractors and farm mechanization for sustainable and precision agriculture.	R & U

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA(M)	PA(I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Introduction to tractors** 1.1 History of Tractors. • Origin of tractors. • Founder of tractors. • Pre-mechanization and early mechanization: animal-drawn implements, limitations, need for mechanization. 1.2 Definition and functions of tractor. 1.3 Classification of tractors. • Based on power, traction, duty, application • Wheel, track, orchard, utility tractors • Electric, hybrid and autonomous tractors 1.4 Comparison of tractors with road automobiles.	05	10%
2.	**Tractor construction and major systems** 2.1 General layout of a farm tractor. 2.2 Types of tractor engines: Gasoline engine, diesel engine, CNG engines, biofuel engines, electric engines, and hybrid engines. 2.3 Tractor clutches: Single-plate, double-plate, split (independent PTO) 2.4 Tractor Transmission: Basic: Sliding mesh, constant mesh, and synchromesh gearbox. Advance and automatic: Collar-shift, power shuttle, powershift/semi powershift, hydrostatic (HST), CVT, range selector, creeper gears. 2.5 Differential and Final Drive: Bull gear, planetary final drive; differential lock. 2.6 Steering system: Manual and power steering in tractors. 2.7 Braking system: Mechanical, hydraulic, oil-immersed brakes; independent wheel braking for turning. 2.8 Tractor controls and instruments: hand/foot throttle, clutch, brake, gear levers, PTO lever, hydraulic levers, differential lock pedal, gauges and warning lights.	15	35%
3.	**Tractor hydraulic system, hitching, PTO and Farm implements.** 3.1 Tractor Hydraulics: Types, components, functions and uses.	15	35%

	3.2 Draft, position, mixed control, Automatic Depth and Draft Control (ADDC) and Electric Quick Raise and Lower (EQRL) and Directional Control Valve (DCV). 3.3 Tractor Hitches: Three-point hitch, drawbar hitch, quick hitch systems, and front hitches. 3.4 Power Take-Off (PTO): Types (independent PTO, live PTO, transmission PTO, split shaft PTO), PTO shaft splines and speeds (540/1000 rpm). 3.5 Tractor ballast and traction: front and rear ballast, tyre selection, inflation pressure, wheel weights and liquid ballast; effect on tractive efficiency and soil compaction. 3.6 Farm implements: • Primary tillage: mould board plough, disc plough, chisel plough, subsoiler. • Secondary tillage: cultivators, harrows (disc, spring-tooth), puddler. • Sowing/planting: seed drill, seed-cum-fertilizer drill, planter. • Intercultural and plant protection equipment: tractor-drawn cultivators, rotary weeders, sprayers and dusters. • Hitching of implements to tractor: mounted, semi-mounted, trailed implements and tipping adjustment: safe hitching practices.		
4.	**Tractor Operation, maintenance, and safety** 4.1 Tractor operation: Pre-start checks, starting and stopping procedures, running-in, basic field operation techniques for different implements. 4.2 Tractor Maintenance: Daily/periodic maintenance schedule, lubrication charts, filter service, cooling system checks, tyre care, and storage. 4.3 Implement maintenance: Replacement of wear parts (shares, discs, tines), adjustments and off-season storage. 4.4 Safety: General safety rules in field and road operation, roll-over hazards and stability, basic legal provisions related to dangerous machines and road traffic for tractors and trailers.	05	10%
5.	**An overview on Recent developments and Future scope in tractors**	05	10%

	& farm equipment 5.1 Recent development: • Advanced Engines (CRDI, variable geometry turbochargers, and electronic engine management systems) • Alternative Fuels (CNG, biodiesel, ethanol blended fuels, and hybrid systems) • Electrification-Zero emissions technology • Smart cab and human factor (Digital touchscreen and joystick controls, ergonomic seats and steering, climate-controlled cabs, reduced vibration and noise, easy-to-use controls, better visibility) 5.2 Future scope: • Precision farming and smart implements. (Tractors are now equipped with AI, IoT sensors, and GPS/GNSS to optimize automated farming) • Autonomous and driver-assist tractors (tractors using GPS, RTK, LiDAR, cameras, and control algorithms, auto steer, lane keeping, semi auto headland turns) • Sustainability and policy aspects (low and zero emission standards, shared tractor as a service (TaaS) models)		
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
40	**40**	**20**	**-**	**-**	**-**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:
(a) Books:

S. No.	**Title of Book**	**Author**	**Publication with place, year and ISBN**
1	Truck and tractor guide	F.D. Graham	D.B. Torapdewals & Sons
2	Farm Machinery	T. P. Singh	PHI Learning,

			ISBN: 9788120352599
3	Farm Tractor Maintenance and Repair	S. C. Jain, C. R. Rai	Standard Publications, ISBN: 9788180140601
4	Textbook Of Tractor at A Glance (A Unique Book of Farm Power)	Sanjay Kumar	CBS Publishers and Distributors Pvt. Ltd. ISBN-13: 978-9386310903
5	Tractors & Agricultural Machinery	K Srinivasan, Vv Narayanan, Sanjeev Kumar Singh	New India Publishing Agency, July 2015 ISBN-139789385516108
6	Maintaining Small-Farm Equipment: How to Keep Tractors and Implements Running Well.	Steve Hansen, Ann Larkin Hansen	Storey Publishing, LLC, Sep 2015, ISBN-13978-1612125275
7	Tractors and their Power Units-Fourth Edition	John B. Liljedahl, Paul K. Turnquist, David W. Smith, Makoto Hoki	CBS Publishers And Distributors Pvt. Ltd., Oct 2004 ISBN 13: 978-9389396645 eBook Packages: Springer Book Archive eBook ISBN:978-1-4684-6632-4
8	Agricultural Equipment Operations	Richard Skiba	After Midnight Publishing, March, 2024 ISBN13: 9781763525436

(b) Open-source software and website:

1. https://nptel.ac.in
2. https://swayam.gov.in
3. https://vlab.co.in
4. https://www.hillagric.ac.in/edu/coa/agengg/lecture/243/Lecture%209%20Farm%20tractor.pdf
5. http://eagri.org/eagri50/FMP211/lec04.html
6. https://www.tractorforeveryone.com/knowledge-center/ultimate-guide-to-tractors-and-their-role-in-modern-farm-mechanization
7. https://www.slideshare.net/slideshow/types-of-tractors-68133875/68133875
8. https://tractorkarvan.com/blog/what-is-a-tractor-meaning-types-uses-and-function#:~:text=With%20modern%20agriculture%2C%20the%20use,PTO%20power%20of%20a%20tractor.
9. https://www.scribd.com/document/789768248/Tractors-Can-Be-Classified-Based-on-Their-Horsepower-Rating#google_vignette

10. https://tractorkarvan.com/blog/how-does-tractor-engine-work
11. https://www.tractorjunction.com/tractor-news/different-types-of-tractor-engines-and-how-they-work/
12. https://www.slideshare.net/slideshow/tractors-its-systems-lec4-fmp211pptx/254920043
13. https://solisworld.com/blog/a-quick-guide-on-different-types-of-tractors/
14. https://tractorkarvan.com/blog/types-of-transmission-and-uses
15. https://www.teamtractor.com/blog/how-tractor-split-brakes-work
16. https://cropilots.com/farm-tractor-brake-types/
17. https://aecotractors.ae/oil-immersed-multi-disc-brake-system-in-tractors/
18. http://elearn.psgcas.ac.in/nptel/courses/video/126105009/lec7.pdf
19. https://www.mahindratractor.com/blog/tractor-pto-types-functions-benefits
20. https://tractorkarvan.com/blog/what-is-ballasting-in-a-tractor
21. https://agritech.tnau.ac.in/expert_system/ragi/farmimplements.html
22. https://www.patelagroindustries.com/blog/modern-farm-implements-and-their-importance
23. https://agrimoon.com/wp-content/uploads/Field-Operation-and-Maintenance-of-Tractors-and-Farm-Machinery-II.pdf
24. https://www.tractorforeveryone.com/knowledge-center/Emerging-Trends-in-Farm-Equipment-for2025#:~:text=Technological%20Integration,the%20groundwork%20for%20smarter%20agriculture.
25. https://www.ceatspecialty.com/gb/blog/equipment/whats-driving-the-future-of-agricultural-equipment

Suggested Course Practical List:

Sr. No	Practical Outcomes (PrOs)		Unit No.	Approx. Hrs. required
1	Identify major external components and systems of a farm tractor (engine, clutch, gearbox, PTO, hydraulics, steering, brakes).		I	02
2	Demonstrate different types tractor engines and their working.		II	04
3	Analyze tractor controls, dashboard instruments, and safety features.		II	02
4	Demonstrate the operation of tractor clutch systems and PTO arrangements.	Any one	II	04
5	Demonstrate three-point linkage, draft and position control; hitching of an implement.		II	04
6	Analyze tractor transmission systems: gearbox types and power flow diagram.	Any one	III	04
7	Demonstrate differential, final drive and differential lock mechanism in tractors.		III	04
8	Familiarization with tractor steering and braking system operations.	Any	III	04

9	Analyze tractor hydraulic system components and control mechanisms.	two	III	04
10	Describe tractor hitching systems: three-point hitch, drawbar, and quick hitch.		III	04
11	Demonstrate Power Take-Off (PTO) system and PTO speed selection	Any one	III	02
12	Study of tractor tyre and functioning of ballast system.		III	02
13	Demonstrate basic tractor operation, routine maintenance schedule, and safety practices.	Any one	IV	02
14	Field demonstration of tractor pre-start checks, starting and stopping procedures, running-in and basic field operation techniques.		IV	02
15	Study of maintenance schedule from a manufacturer's tractor manual and preparation of service chart.		IV	02
16	Identify improved ergonomic cab design and the human factors of a modern tractor.		V	02
	Total Hrs.			**30**

List of Laboratory/Learning Resources Required:

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
1	1 farm tractor (35–50 hp class) with: Modern and improved ergonomic cab design, advanced engine and transmission, three-point linkage, PTO, hydraulic lift and trailer hitch for demonstration and study purpose.	1,3,10,11,16
2	**Implements and farm machinery** • Primary tillage: - 1 mould-board plough (tractor mounted). - 1 disc plough. • Secondary tillage: - 1 disc harrow. - 1 cultivator. • Sowing and planting: - 1 seed drill / seed-cum-fertilizer drill.	5,9,10

	- Intercultural / soil working - 1 rotary tiller / rotavator. • Plant protection: - 1 tractor-operated sprayer or power sprayer.	
3	1 cut-section or demonstration model of a diesel tractor engine (or actual overhauling engine).	2
4	Cut-section or sample assemblies of: clutch, gearbox, differential, final drive, and brake system (or at least wall charts)	4,6,7,8
5	Hydraulic system teaching unit / transparent circuit model (or actual tractor hydraulic components on bench)	9
6	Standard mechanic's tool kit (spanners, screwdrivers, pliers, hammers, pullers, torque wrench, grease gun)	13
7	Oil drain pans, funnels, filter wrench, and cleaning trays for maintenance demonstrations.	13
8	Tyre pressure gauge and foot/air pump	12,13
9	Display charts/manuals: tractor layout, linkage geometry, safety rules and periodic maintenance charts.	14,15
10	Personal protective equipment: safety shoes, gloves, goggles, masks for spraying operations and ear protection as needed	12,13
11	First-aid box, fire extinguisher, and safety sign boards in lab.	13

Suggested Project List:

Prepare a detail report on a visit to a tractor dealership/workshop for study/observation of latest tractor models and their functioning.
Make charts/banners of history and classification of agricultural tractors.
Make charts/banners on recent developments of agricultural tractors.
Conduct a survey to study the recent market trends: growth in agricultural tractor machinery market, demand for compact and specialty tractors, service and retrofit opportunities.
Prepare power point presentation on Electrification and hybridization of tractors.
Prepare power point presentation on Connected and data-driven mechanization of tractors.
Prepare power point presentation on Autonomous and driver-assist tractors.
Collect spare parts or different components of tractors (preferably small components/used

one/replaced during repairs and maintenance) for demonstration and study.
Prepare maintenance chart/service schedule chart for a farm tractor.
Collect brochures of different make tractors and make a list of specifications available in different categories of tractors.
Conduct a survey by visiting 5 farms; document implements that are used, problems in tractor operation and maintenance, usage patterns and repair needs.
Prepare a list of future scope technologies that can be implemented in tractors for smart farming and human factors.
Collect data on the availability of government aids and subsidies to help and encourage farming.

Suggested Activities for Students: If any

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of each activity. They should also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a) Charts can be prepared.
b) Small report on any topic given by concern faculty.
c) Small groups of students can be formed for assigned work. Assigned work should be such that it covers market survey, team work, presentation, time management, quality development.

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