4th Semester	**RAG4C001**	**Tractor Engines, Systems & Controls**	**L-T-P 3-0-0**	**3 CREDITS**

Module- I (9 Hours)

Sources of Farm Power and Classification of Tractors and IC Engines.
Farm Power- Conventional and non-conventional sources, merits and demerits; Tractors and IC Engines – classifications, working principle, fuel used and different design criteria. Review of thermodynamic principles of engines and deviation from ideal cycle- thermal efficiency of Otto, Diesel and Dual cycle, problems; Components of IC Engine and Strokes and Valve System - engine components, construction, operating principles and functions; comparison of 2/4 stroke and SI and CI engines; valve mechanism in 4-stroke engines, valve timing diagram, valve clearance adjustment; cam profile, valve lift and valve opening area.

Module- II (9 Hours)

Air Cleaning System, Fuel Supply System/ Fuel Injection System and Ignition of SI Engines
Air cleaners and their performance characteristics; Fuels, their properties, detonation and knocking, air-fuel ratio, tests on fuel for SI and CI engines, carburetion system and carburetors; Injection pump - types, working principles; fuel injector nozzles, types and working principle; ignition system of SI engines, electrical system including battery, starting motor, battery charging, cut-out, etc and comparison of dynamo and alternator.

Module- III (8 Hours)

Engine Lubrication, Cooling, Governing and Testing.
Lubrication system, lubricants - physical properties, additives and their application; cooling need and methods and main functional components, thermostat valves, additives in the coolant, radiator efficiency; governors, types and governor characteristics; familiarization with the basics of engine testing

Module- IV (10 Hours)

Different systems in a tractor.
Power transmission system and function; Clutch types ; operation of gear box and their components; Types of gear box - sliding mesh, Constant mesh, synchromesh type; Differential and final drive system; Calculation of gear reduction. Brake system- brake system of tractor, braking torque, brake fade; Steering System- Pure rolling/ true rolling condition for steering system; Components of steering mechanism, lock angles and steering geometry; Ackerman steering mechanism; Steering systems in track type tractors; Hydraulic System- Familiarization of hydraulic system and ADDC.

Module- V (9 Hours)

Power Outlet- PTO drive, types and standards; traction, terminologies of traction; Shear force and rolling resistance calculation; wheels, tyres construction and specifications; Stability of Tractor- Tractor chassis mechanics, forces acting on tractor; Weight transfer; Longitudinal stability and drawbar pull; Lateral stability; Effect of speed on lateral stability during turning of tractor; Location of cg of tractor, various methods of determination of cg of tractor.

Ergonomics- Ergonomical considerations for tractor; Noise and vibration in tractor; Safety- Operational safety requirements, ropes; Tractor testing- Purpose of testing, BIS test codes for tractor and engine

Books:

1. Liljedahl J B, Turnquist P K , Smith, D W and Hoki M. “Tractors and Their Power Units.
2. Rodichev V and G Rodicheva. “Tractors and Automobiles.”
3. Mathur ML and RP Sharma. “A course in Internal Combustion Engines.”
4. Singh Kirpal. “Automobile Engineering – Vol II”.
5. Heitner Joseph. “Automotive Mechanics: Principles and Practices.”
6. Goering C E, Hansen A. C. “Engine and Tractor Power.”
7. Tractor and their Power Units, by Barger E l , Liljedahl J B & Mc Kibben E C, Wiley Eastern
8. Automobile Engg. by Kripal Singh, Standard Publisher and Distributers, Delhi-6
9. Farm Tractor, Maintenance and Repair, by SC Jain and C R Rai Standard Publisher and Distributers, Delhi-6
10. Automobile Mechanics (SI Units), by N K Giri, Khanna Publishers, Delhi -6
11. Engineering Principles of Agricultural Machines, by A. K. Srivastav, C.E. Goering and r. p. Rohrbach
12. The Mechanics of Tractor- Implement performance. Theory and Worked Example, by Macmillan RH University of Melbourne
13. BIS Test codes for tractor.