Semester	**:**	**V**		
Course No.	**:**	**FMPE-356**	**Credit Hrs.**	**: 3(2+1)**
Course Title	**:**	**Tractor and Automotive Engines**		

SYLLABUS

Objectives : (i) To acquaint students with the working principles of internal combustion engines and tractors,

(ii) To develop understanding of the construction and functioning of different engine and tractor systems.

THEORY

Sources of Farm Power, Conventional and non-conventional energy sources; Classification of tractors and IC engines, Review of Thermodynamic principles of IC (CI and SI) engines and deviation from ideal cycle; General energy equation and heat balance sheet; Derivation of thermal efficiency of Otto cycle, Diesel cycle and Dual cycle; Mechanical, thermal and volumetric efficiencies. Study of engine components their construction, operating principles and functions; Engine strokes and comparison of 2-stroke and 4-stroke engine cycles, and CI and SI engines; Engine valve systems, valve mechanism, valve timing diagram, valve clearance adjustment; Cam profile, valve lift and valve opening area. Inlet and exhaust systems; Importance of air cleaning system; Types of air cleaners and performance characteristics of various air cleaners; Fuel supply system, types of fuels, properties of fuels, calculation of air-fuel ratio. Different tests on fuel for SI and CI engines; Detonation and knocking in IC engines; Carburetion system, carburetors and their main functional components; Fuel injection system-injection pump, their types, working principles; Fuel injector nozzles- types and working principles. Engine governing need of governors, governor types and governor characteristics; Lubrication system- need, types, functional components; Lubricants- physical properties, additives and their application. Engine cooling system- need, cooling methods and main functional components; Need and types of thermostat valves; Additives in the coolant; Radiator efficiency. Ignition system of SI engines; Electrical system including battery, starting motor, battery charging, cut-out etc.; Comparison of dynamo and alternator; Basics of engine testing.

PRACTICAL

Study of different systems of CI engines; Study of engine parts and functions, working principles etc.; Study of valve systems construction and adjustments; Determination of physical properties of oil and fuel; Study of air cleaning system, fuel supply system of SI engine; Study of diesel injection system and timing; Study of cooling system and fan performance, thermostat and radiator performance evaluation; Study of part load efficiencies and governing; Study of lubricating system and adjustments; Study of starting and electrical system; Study of ignition system; Study of tractor engine heat balance and engine performance curves; Study of dynamo; Visit to a nozzle calibration unit; Visit to engine manufacturer/ assembler/ spare parts agency.

TEACHING SCHEDULE

THEORY [FMPE-356]

Lecture No.	Topic	Subtopics/ Key Points	Weightage (%)
1 - 2	Farm Power	Sources of Farm power, Conventional and non-conventional energy sources	5
3 - 10	Internal Combustion Engine	Classification of tractors and IC engines, Review of Thermodynamic principles of IC (CI and SI) engines and deviation from ideal cycle; General energy equation and heat balance sheet; Derivation of thermal efficiency of Otto cycle, Diesel cycle and Dual cycle; Mechanical, thermal and volumetric efficiencies. Study of engine components, their construction, operating principles and functions; Engine strokes and comparison of 2-stroke and 4-stroke engine cycles and CI and SI engines	25
11 - 13	Valve Mechanism	Engine valve systems, valve mechanism, valve timing diagram, valve clearance adjustment; Cam profile, valve lift and valve opening area	10
14 - 16	Air Intake Exhaust System	Inlet and exhaust systems; Importance of air cleaning system; Types of air cleaners and performance characteristics of various air cleaners	10
17 - 19	Fuel system	Fuel supply system, types and properties of fuels, calculation of air-fuel ratio. Different tests on fuel for SI and CI engines; Detonation and knocking in IC engines; Carburetion system, carburetors and their main functional components; Fuel injection system-injection pump, their types, working principles; Fuel injector nozzles- types and working principles	10
20 - 21	Governor	Engine governing need of governors, governor types and governor characteristics	5
22 - 24	Lubrication system	Lubrication system- need, types, functional components; Lubricants- physical properties, additives and their application	10
25 - 27	Cooling System	Engine cooling system- need, cooling methods and main functional components; Need and types of thermostat valves; Additives in the coolant; Radiator efficiency	10
28 - 31	Ignition System	Ignition system of SI engines; Electrical system including battery, starting motor, battery charging, cut-out etc.; Comparison of dynamo and alternator	10
32	Engine Testing	Basics of Engine Testing	5
		Total =	**100**

TEACHING SCHEDULE

PRACTICAL [FMPE-356]

Exercise No.	Exercise Title
1	Study of different systems of CI engines.
2	Study of engine parts, their functions and working principles.
3	Study of valve systems construction and adjustments.
4	Determination of physical properties of oil and fuel.
5	Study of air cleaning system; fuel supply system of SI engine.
6	Study of diesel injection system and timing.
7 - 8	Study of cooling system and fan performance, thermostat and radiator performance evaluation.
9	Study of part load efficiencies and governing.
10	Study of lubricating system and adjustments.
11	Study of ignition system.
12	Study of tractor engine heat balance and engine performance curves.
13	Study of starting and electrical system.
14	Study of dynamo.
15	Visit to a Nozzle calibration unit.
16	Visit to Engine manufacturer/ assembler/ spare parts agency.

Suggested Readings [FMPE-356]:

1. Ganesan, V., 1999. Internal Combustion Engines. McGraw Hill, New Delhi.
2. Goering, C.E. and Hansen, A.C., 2004. Engine and Tractor Power. ASAE. St. Joseph, Michigan.
3. Heitner, J., 2004. Automotive Mechanics: Principles and Practices. CBS Publishers.
4. Liljedahl, J.B., Turnquist, P.K., Smith, D.W. and Hoki, M., 1989. Tractors and their Power Units. Van Nostrand Rainhold, New York.
5. Mathur, M.L. and Sharma, R.P., 1996. A Course in Internal Combustion Engines. Dhanpat Rai and Sons, New Delhi.
6. Rodichev, V. and Rodicheva, G., 1984. Tractors and Automobiles. Mir Publishers, Moscow.
7. Singh, K., 2020. Automobile Engineering. Vol II. Standard Publishers and Distributors.