

FARM POWER AND ENGINE SYSTEM

ENAE 202

Lecture : 3
Tutorial : 1
Practical : 2

Year : II
Part : I

Course Objectives:

The objective of this course is to acquire knowledge of prime sources of power utilized in agricultural field, internal combustion engine, its operating system and function, and estimate the power produced by engine and animal.

1 Introduction to Farm Power (2 hours)

- 1.1 Role of farm power in agricultural mechanization
- 1.2 Survey of farm power
- 1.3 Agricultural mechanization and labor requirement

2 Animate and Inanimate Sources of Farm Power (4 hours)

- 2.1 Sources of farm power and their utilization: Human power, animal power, electrical power, mechanical power, solar energy, wind energy, bio-gas and micro-hydro
- 2.2 Availability, advantages and limitations of farm power sources
- 2.3 Account of farm power sources in Nepal
- 2.4 Animal power harnesses
 - 2.4.1 Measurement of human and animal power
 - 2.4.2 Yokes and harnesses for draught animals
 - 2.4.3 Walking type farm machines and equipment
 - 2.4.4 Riding type farm machines and equipment
 - 2.4.5 Transport equipment
 - 2.4.6 Design parameters for animal harnesses

3 Internal Combustion (IC) Engines (6 hours)

- 3.1 Introduction to IC engine
- 3.2 Operational parameters of IC engines
- 3.3 Classification of IC engines
- 3.4 Working cycles of IC engines
- 3.5 Two-stroke and four-stroke cycle engines
- 3.6 Spark ignition and compression ignition engines
- 3.7 Engine components and their construction
- 3.8 Firing order, firing interval and criteria for selection of firing order

4 Performance of IC Engines (7 hours)

- 4.1 Power and Its measurements
 - 4.1.1 Concept of horse power
 - 4.1.2 Relation between mechanical and electrical power units
 - 4.1.3 Purpose and types of dynamometer
 - 4.1.4 Indicated power, brake power, mean effective pressure
 - 4.1.5 Engine efficiency
 - 4.1.6 Heat balance for IC engine
 - 4.1.7 Power, torque and speed relationship
 - 4.1.8 Specific fuel consumption

5 Operating Principle and Function of Engine Systems (24 hours)

- 5.1 Valve operating system
 - 5.1.1 Valve arrangement
 - 5.1.2 Components involved in valve operation
 - 5.1.3 Cam profile and valve lift
 - 5.1.4 Valve timing and valve clearance
 - 5.1.5 Valve adjustment and maintenance
- 5.2 Intake and exhaust system
 - 5.2.1 Components involved in intake and exhaust system
 - 5.2.2 Air cleaning system and types
 - 5.2.3 Performance of different air cleaners
 - 5.2.4 Maintenance of intake and exhaust system
- 5.3 Engine fuels and fuel supply system
 - 5.3.1 Properties of fuels used in IC engines
 - 5.3.2 Calorific and heating values of fuels
 - 5.3.3 Octane and Cetane number
 - 5.3.4 Test of gasoline and diesel fuel
 - 5.3.5 Combustion equation for hydrocarbon fuels
 - 5.3.6 Combustion in spark ignition and compression ignition engines
 - 5.3.7 Air-fuel ratio and mixture requirements
 - 5.3.8 Carburetion and working principle of carburetor
 - 5.3.9 Working principle and components of diesel fuel supply system
 - 5.3.10 Working principle and components of petrol fuel supply system
 - 5.3.11 Working principle and components of petrol injection system, electronic fuel injection (EFI) and multipoint fuel injection (MPFI) system
 - 5.3.12 Working principle and components of common rail direct injection (CRDI) system
 - 5.3.13 Turbo charging and supercharging
 - 5.3.14 Governor and governor control, purpose, types and working principle, stability, hunting, regulation and sensitivity, troubles and remedies

- 5.4 Ignition system
 - 5.4.1 Purpose and types
 - 5.4.2 Components and function of the ignition system
 - 5.4.3 Pre-ignition and ignition delays
 - 5.4.4 Ignition timing, ignition advance and retard
 - 5.4.5 Detonation and knocking in IC engine
- 5.5 Cooling system
 - 5.5.1 Purpose and types of cooling system
 - 5.5.2 Working principle and components of air cooling system
 - 5.5.3 Working principle and components of pressure water cooling system
 - 5.5.4 Corrosion and corrosion inhibitors
 - 5.5.5 Antifreeze mixture
 - 5.5.6 Cooling system tune-up
- 5.6 Lubrication system
 - 5.6.1 Purpose and types of engine lubrication system
 - 5.6.2 Lubricating oil classification
 - 5.6.3 Properties of lubricants
 - 5.6.4 Additives in lubricating oil and pollution
 - 5.6.5 Selection parameters of lubricating oil
 - 5.6.6 Components of pressure feed lubrication system
 - 5.6.7 Maintenance of lubrication system
- 5.7 Starting and electrical system
 - 5.7.1 Working principle and components of self-starting system
 - 5.7.2 Storage battery and its maintenance
 - 5.7.3 Charging, lighting and horn system
 - 5.7.4 Maintenance of electrical system

6 Small Engines for Farm Operations (2 hours)

- 6.1 Stationary engines for farm operations
- 6.2 Range and availability in the country
- 6.3 Selection of engines for farm operations

Tutorial (15 hours)

- 1. Estimate of human and animal power for operation of farm implements
- 2. Preparation of power overlap chart
- 3. Estimation of power of engine and its performances
- 4. Preparation of heat balance sheet
- 5. Calculation of heating value of hydrocarbon fuels

Practical (30 hours)

- 1. Dismantling of an IC engine, identification of major parts and measurement of basic dimensions
- 2. Study on working principle of two-stroke and four stroke cycle spark ignition and compression ignition engines, firing interval, firing order and valve timing

3. Study on intake and exhaust system and air-cleaners
4. Study on fuel supply system of compression ignition engines
5. Study on fuel supply system of spark ignition engines
6. Study on cooling system in IC engines
7. Study on lubrication system in IC engines
8. Study on governors and governing system in IC engines
9. Study on electrical and starting system
10. Oil and fuel test
11. Starting of engine and making adjustments in engine systems
12. Study on engine maintenance schedule, troubles and their remedies

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Marks distribution*
1	2	4
2	4	6
3	6	8
4	7	8
5	24	32
6	2	2
Total	45	60

* There may be minor deviation in marks distribution.

References

1. Pulkrabek, W.W. (2003). Engineering fundamentals of the internal combustion engine (2nd edition). Prentice Hall.
2. Ganesan, V. (2008). Internal combustion engines (4th edition). Tata McGraw-Hill Education.
3. Mathur, M.L., Sharma, P. (2014). Internal combustion engines. Dhanpat Rai Publications.
4. Moses, B.D., Frost, N.R. (1973). Farm power. John Wiley & Sons.
5. Jones, F. R. (1952). Farm gas engines and tractors. McGraw-Hill.
6. Ojha, T.P., Michael, A.M. (2005). Principles of agricultural engineering, Vol. I. Jain Brothers.
7. Liljedahl, J.B., Turnquist, P.K., Smith, D.W., Hoki, M. (1989). Tractors and their power units (3rd edition). CBS Publishers.
8. Singh, K. (2008). Automobile engineering (Vol. 2). Standard Publishers Distributors.
9. Crouse, W.H., Anglin, D.L. (2010). Automotive mechanics (10th edition). McGraw-Hill Education.