

3.1 APPLIED MECHANICS

L T P
Periods/week 4 - 2

RATIONALE

The subject Applied Mechanics deals with basic concepts of mechanics like laws of forces, moments, friction, centre of gravity, laws of motion and simple machines which are required by the students for further understanding of other allied subjects. The subject enhances the analytical ability of the students.

DETAILED CONTENTS

1. Introduction (08 period)

- 1.1 Concept of engineering mechanics definition of mechanics, statics, dynamics, application of engineering mechanics in practical fields. Definition of Applied Mechanics.
- 1.2 Definition, basic quantities and derived quantities of basic units and derived units
- 1.3 Different systems of units (FPS, CGS, MKS and SI) and their conversion from one to another density, force, pressure, work, power, velocity, acceleration
- 1.4 Concept of rigid body, scalar and vector quantities

2. Laws of forces (12 period)

- 2.1 Definition of force, measurement of force in SI units, its representation, types of force: Point force/concentrated force & Uniformly distributed force, effects of force, characteristics of a force
- 2.2 Different force systems (coplanar and non-coplanar), principle of transmissibility of forces, law of super-position
- 2.3 Composition and resolution of coplanar concurrent forces, resultant force, method of composition of forces, laws of forces, triangle law of forces, polygon law of forces - graphically, analytically, resolution of forces, resolving a force into two rectangular components
- 2.4 Free body diagram
- 2.5 Equilibrant force and its determination
- 2.6 Lami's theorem (concept only)

[Simple problems on above topics]

3. Moment (10 period)

- 3.1 Concept of moment
- 3.2 Moment of a force and units of moment
- 3.3 Varignon's theorem (definition only)
- 3.4 Principle of moment and its applications (Levers – simple and compound, steel yard, safety valve, reaction at support)
- 3.5 Parallel forces (like and unlike parallel force), calculating their resultant
- 3.6 Concept of couple, its properties and effects
- 3.7 General conditions of equilibrium of bodies under coplanar forces and beams, fixed support, roller, support, over hanging, Uniformly distributed load, point load, varying load
- 3.8 Position of resultant force by moment
[Simple problems on the above topics]

4. Friction (10 period)

- 4.1 Definition and concept of friction, types of friction, force of friction
- 4.2 Laws of static friction, coefficient of friction, angle of friction, angle of repose, cone of friction
- 4.3 Equilibrium of a body lying on a horizontal plane, equilibrium of a body lying on a rough inclined plane, friction in simple screw jack
- 4.4 Calculation of least force required to maintain equilibrium of a body on a rough inclined plane subjected to a force:
 - a) Acting along the inclined plane Horizontally
 - b) At some angle with the inclined plane*[Simple problems on the above topics]*

5. Centre of Gravity (08 period)

- 5.1 Concept, definition of centroid of plain figures and centre of gravity of symmetrical solid bodies
- 5.2 Determination of centroid of plain and composite lamina using moment method only, centroid of bodies with removed portion
- 5.3 Determination of center of gravity of solid bodies - cone, cylinder, hemisphere and sphere; composite bodies and bodies with portion removed
[Simple problems on the above topics]

6. Moment of Inertia (06 period)

Concept of moment of inertia and second moment of area and radius of gyration, theorems of parallel and perpendicular axis, second moment of area of common geometrical sections: rectangle, triangle, circle (*without derivations*). Second moment of area for L, T and I sections, section modulus.

7. Simple Machines (10 period)

- 7.1 Definition of effort, velocity ratio, mechanical advantage and efficiency of a machine and their relationship, law of machines
- 7.2 Simple and compound machine (Examples)
- 7.3 Definition of ideal machine, reversible and self locking machine
- 7.4 Effort lost in friction, Load lost in friction, determination of maximum mechanical advantage and maximum efficiency
- 7.5 System of pulleys (first, second, third system of pulleys), determination of velocity ratio, mechanical advantage and efficiency
- 7.6 Working principle and application of wheel and axle, different pulley blocks, simple screw jack, worm and worm wheel, single and double winch crab. Expression for their velocity ratio and field of their application
[Simple problems on the above topics]

LIST OF PRACTICALS

- 1. Verification of the following laws:
 - a) Parallelogram law of forces
 - b) Triangle law of forces
 - c) Polygon law of forces
- 2. To verify the forces in different members of jib crane.
- 3. To verify the reaction at the supports of a simply supported beam.
- 4. To find the Mechanical Advantage, Velocity Ratio and efficiency in case of an inclined plane.
- 5. To find the Mechanical Advantage, Velocity Ratio and efficiency of a screw jack.
- 6. To find the Mechanical Advantage, Velocity Ratio and efficiency of worm and worm wheel.
- 7. To find Mechanical Advantage, Velocity Ratio and efficiency of single purchase crab.
- 8. To find out center of gravity of regular lamina.

9. To find out center of gravity of irregular lamina.
10. To determine coefficient of friction between three pairs of given surface.

RECOMMENDED BOOKS

1. A Text Book of Applied Mechanics by S Ramamurtham, Dhanpat Rai Publishing Co. Ltd.
2. A Text Book of Engineering Mechanics (Applied Mechanics) by RK Khurmi; S Chand and Co. Ltd., New Delhi.
3. A Text Book of Applied Mechanics by RK Rajput; Laxmi Publications, New Delhi.
4. Text Book of Applied Mechanics by Birinder Singh, Kaption Publishing House, New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	08	08
2	12	16
3	10	18
4	10	18
5	08	10
6	06	08
7	10	16
Total	64	100

3.2 MINOR IRRIGATION AND TUBE WELL ENGINEERING

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RATIONALE

The knowledge of this subject will enable the learner to know the importance of minor irrigation networks and tube well engineering in increasing the agricultural production. Design of the network and tube wells with optimum efficiency will help generating extra income through cash crops etc. to the farmers.

DETAILED CONTENTS

A. Minor Irrigation

1. Introduction (04 periods)
Importance, necessity and advantages of minor irrigation
2. Planning and Layout (05 Periods)
Planning and layout of minor irrigation network
3. Water lifting devices and solar pumps (08 Periods)
indigenous water lifting devices; Wind mills, hydrams, solar water pumps, principles, constructional details and working
4. Sources of Minor Irrigation in plain and hilly terrain (06 Periods)
Shallow and deep wells, water tanks and ponds

B. Ground Water and Tube Well Engineering

5. Introduction (05 Periods)
Occurrence and movement of ground water, aquifer and its type, classification of wells, steady and transient flow into partially, fully and non-penetrating and open wells, Definition of tube well, need, advantages and disadvantages
6. Selection of Site (04 Periods)
Characteristics of tube well site, factor affecting site selection. Use of resistivity meters

7. Drilling Methods (06 Periods)
Types of drilling methods, advantages of different methods. Types of rigs; rotary and percussion rigs, rock drilling machine, their construction, installation and working. Development of tube wells by high capacity air compressors
8. Tube Wells (05 Periods)
Types of tube well, advantages and disadvantages of each type, selection of tube well for a given site.
9. Strainers (02 Periods)
Types, methods of design, comparison of different types of strainers
10. Open Wells (03 Periods)
Design and construction of open wells
11. Pump and Pumping Equipments (10 Periods)
Types, main features, working principle, selection of pump and pumping equipment, centrifugal pump, performance, installation, operation and maintenance
12. State Tube Wells (04 Periods)
Importance in increasing agriculture production, command area and government policy about tube wells
13. Tubewells as Recharging Structure (05 Periods)
Gravity recharging, injection

LIST OF PRACTICALS

1. Study of single acting and double acting reciprocating pumps and testing,
2. Study of radial flow and mixed flow centrifugal pumps,
3. Study of multistage centrifugal pumps, turbine, submersible and propeller pumps,
4. Installation of centrifugal pump at given location,

5. Testing of centrifugal pump,
6. Study about the minor irrigation system in hilly areas
7. Study of different drilling equipments,
8. Sieve analysis for gravel and well screens design,
9. Study about the unconfined and confined aquifer
10. Testing of well screen in sand tank model in unconfined conditions,
11. Visits to drilling sites, Measurement of water level and drawdown in pumped wells,
12. Visit and study about solar pumps – operation and its maintenance

RECOMMENDED BOOKS

1. Principles of Agriculture Engineering (Vol. II) by AM Michael and TP Ojha.
2. Land and Water Management Engineering by VVN Murthy.
3. Irrigation Theory and Practice by AM Michael, Vikash Publishing House
4. Irrigation Principles and Practices by OW Israelson
5. Handbook of Farm Irrigation Structures by AM Michael, et.al. IARI.
6. Ground water by H M Raghunath, Wiley Eastern Limited, New Delhi
7. Land Water Management Principles by R Suresh, Standard Publishers Distributors, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	4	6
2	5	8
3	8	10
4	6	10
5	5	10
6	4	6
7	6	8
8	5	7
9	2	5
10	3	5
11	10	12
12	4	7
13	5	6
Total	64	100

RATIONALE

A diploma holder in agriculture engineering has to work with various types of soils in the field. This subject is aimed to equip the students with the capability of identifying various types of soils, their properties and behaviour in the field conditions.

In addition to above the knowledge of soil mechanics is also necessary in connection with the embankment or filling of earth while leveling the land. The curriculum of this subject has been developed to cater to the above mentioned needs.

DETAILED CONTENTS**A. Soil Science**

Origin and Classification of Soils (08 Periods)

1. Origin of soils, weathering of rocks and formation of horizon, composition of soils, structure of soils. Classification of soils (based on agriculture needs. IS classification of soil, triangular classification of soil. Distinction between clay, loam and sandy soils.

2. Physical Proportion of Soil (08 Periods)

Texture, particle density, structure, bulk density, porosity, air and water in soil, temperature, consistency and organic matter

3. Chemistry of Soils (08 Periods)

Soil water plant relation, soil mineral and chemical classification (Acid soil, calcareous soil and saline soil), elementary exposure. Methods of reclamation of acid and alkaline soil.

4. Introduction to Bio-Fertilizers i.e. vermi-compost, organic fertilizer, FYM, its importance . (04 Periods)

B) Soil Mechanics

5. Introduction (12 Periods)

a) Natural, residual and transported soil. Weight, volume relationship, determination of soil unit weights, water content and void ratio. Structure of soil – granular and cohesive soil. Soil colloids and Brownian motion

- b) Grain Size Distribution: Sieve analysis, Stock's law, hydrometer analysis (basic concept only), grain size accumulation curves-their plotting and interpretation, IS soil classification
6. Engineering Properties of Soil (18 Periods)
- a) Consistency of soil: Atterburg's limit, method of determination of liquid limit and plastic limit, plasticity index, plotting of flow curve on semilog graph.
- b) Permeability of soil: Darcy's law, coefficient of permeability, parameters affecting permeability, parameters, quick sand condition, seepage through soils.
- c) Compaction and consolidation of soil: Concept of compaction and consolidation, difference between them, optimum moisture content, dry density, Procter compaction test, use of optimum moisture content in embankment
- d) Shear strength of soil: Definition of shear strength, Coulomb's Law, direct shear box test and shear vane test
- e) Bearing capacity of soil: Definition, net ultimate and safe bearing capacity, plate load test
7. Subsurface Investigation (08 Periods)
- Preliminary exploration, test pit, different methods of boring, augers, methods of sampling, sealing of samples, disturbed, representative and undisturbed samples, split spoon sampler

LIST OF PRACTICALS

A) Soil Science

1. Determination of moisture tension with Tensiometer
2. Determination of wilting point
3. pH value determination
4. Classification of soil and field identification test

(B) Soil Mechanics

5. Determination of grain size distribution by sieve analysis
6. Determination of liquid limit and plastic limit
7. Determination of permeability by constant and variable head permameter

8. Determination of shear strength by direct shear box test
9. Determination of OMC by Procter compaction test
10. Determination of field density by core cutter method and sand replacement method

RECOMMENDED BOOKS

1. Soil Mechanics and Foundation Engineering by KR Arora, Standard Book, Delhi
2. Soil Mechanics and Foundations by BC Punmia, Ashok K Jain and Arun K Jain, Luxmi Publishing, New Delhi
3. Soil Mechanics and Foundation Engineering by VNS Murthy, Dhanpat Rai and Sons, Jalandhar
4. Soil Mechanics by Alam Singh and BC Punmia, Standard Book House, Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	8	8
2	8	12
3	8	8
4	4	8
5	12	20
6	18	32
7	8	12
Total	64	100

RATIONALE

The course aims at enabling the students to do land and water survey, prepare maps/plans for simple irrigation works and drainage channels, road alignment. It also enables the students to carry out field levelling and contour maps of the farm and forest etc.

DETAILED CONTENTS

1. Introduction (02Periods)
 Definition of surveying and levelling, purpose, linear and angular units of measurement, instruments used for taking these measurements, basic principle of surveying, classification of survey
2. Measurement of Distances (04 Periods)
 Instruments used, types of chain, chaining of a line, ranging, line ranging, reciprocal ranging, setting out a right angle, optical square, cross staff, offset – single and oblique, errors in chaining by a faulty chain, chaining on sloppy ground
3. Chain survey (08 Periods)
 Definition of terms, survey, station, base line, til line, check line, running measurement. Triangulation of an area, well conditioned triangle, methods of booking a survey line. Plotting of a survey line, symbols and conventional signs, permissible errors, obstacles in chain survey
4. Measurement Area (02 Periods)
 Direct measurement of area, on paper by planimeter, Simpson's rule, average ordinate rule, trapezoidal rule, enlargement and valuation of a plan
5. Compass Survey (06 Periods)
 Purpose, concept of meridians – magnetic true and arbitrary, bearing of a line, types of bearing, systems of bearing, fore bearing and back bearing, diploima and declination, conversion of bearing from one system to other, calculation of included angles and bearings, calculation of bearings when included angles and bearing of some lines is given local attraction, construction, principle and working of prismatic compass and surveyor compass, traversing by compass, closed and open traverse, plotting of a traverse – included angle method and definition angle method, closing error, graphical method of adjustment of closing error, errors in compass survey, permissible error

6. Plane Table Survey (06 Periods)
Plane table and its accessories, adjustments of a plane table, entering, levelling and orientation method of plane tabling – radiation, intersection, traversing and resection, errors in plane table survey, advantages and disadvantages of plane table survey.
7. Levelling (08 Periods)
Definition of terms, levelling, level and horizontal surface, datum-standards and ordinary reduced level, bench mark, types of benchmarks, methods of levelling, direct and indirect levelling, scope and utility, direct leveling – instruments, hand level clinometer, levelling staves, merit and demerits of different types of staves and their use, levelling field book, fly levelling and check levelling, longitudinal levelling, cross sectional levelling, plotting of profile, methods of drawing longitudinal and cross section of a channel, drainage and road.
8. Theodolite (06 Periods)
Types of theodolite, different parts of a transit theodolite, different axes of a theodolite, relation between them, temporary adjustment of a theodolite, measurement of horizontal and vertical angles by theodolite, methods of reading, bearing by a theodolite
9. Contouring (04 Periods)
Definition of contour line, grade contour, horizontal equivalent, vertical interval, contours of a hill, pond, valley, ridge, vertical valley line, ridge of water shed line, drawing contours – direct and indirect methods of contouring
10. Minor Instruments (02 Periods)
Abney level, cylone ghat tracer, tangent clinometer
An introduction to all basic operations of surveying
- 11 work with the help of Total Station. (03 Periods)

LIST OF PRACTICALS

1. To find out distance between two an approachable object
2. Plan of a small area by means of a chain surveying
3. Plan of a small area by means of a compass surveying
4. Plan of a small area by means of a plane table surveying
5. Contour man of an area with at least 3 meter up and down area
6. Plan for land acquisition and checking it with sajra plan .
7. To plot the longitudinal section of a canal showing the ground level for at least one Km length
8. To determine the elevation difference between two points by levelling with at

- least five shifting of instruments
9. To find out the vertical height of an object by use of angle of elevation and depression (Theodolite)
 10. To find out horizontal distance between two points by theodolite
 11. To find out the vertical height of an object by theodolite
 12. Use of minor instruments .
 13. Use of Total Station.

RECOMMENDED BOOKS

1. Textbook of Surveying by BC Punmia , Standard Book House, New Delhi
2. Fundamentals of Surveying and Levelling by CL Kochhar, Katson Publishing House, Ludhiana
3. Surveying by SK Duggal
4. Surveying by R Agore
5. Surveying and Levelling by TP Kanetkar and SV Kulkarni, AVG Prakashan, Pune

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	2	4
2	4	8
3	6	18
4	2	4
5	6	12
6	6	12
7	8	18
8	6	12
9	4	8
10	2	4
11	3	6
Total	48	100

3.5 Operation, Care and Maintenance of Tractors and Machines

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RATIONALE

This is a practice-oriented subject, which will create the ability and develop the skill to carry out different agricultural operations for raising the crops using tractors and matching farm equipment. It will also enable the students to handle and operate the machines and implements used for crop production and carry out the minor repair and adjustments of machines for effective and efficient machinery usage.

DETAILED CONTENTS

1. Familiarization with different gauges and controls of tractors, pre operational checks and precautions
2. Tractor driving practices without implements in limited space like L shape, Circle, “8” etc.
3. Tractor trolley reversing in limited space and turning .
4. Operation of primary tillage equipment in field. Controlling the speed of operation, gear selection, adjustments in the machine for different operations
5. Operation of secondary tillage equipment, seed bed preparation, gear selection, adjustments in machine desired results.
6. Operation of sowing and planting equipment, gear selection, adjustments in the machine for proper seed placement, calibration for proper seed and fertilizer application and care of machines.
7. Operating various plant protection equipment, adjustments, nozzle calibration, and care of equipment and precautions
8. Familiarization of power tillers and their controls, operations of equipment with power tillers with care of machines and precautions.
9. Measurement of speed, slip, draft, field efficiency, field capacity & fuel consumption of tractor during field operations.

RATIONALE

The topics covered in the subject will enable the students to understand the basic principles, construction and working of farm machinery for different crops. This will also enable them to select appropriate machinery, use, repair and maintain the same. This knowledge will be highly useful in running an Agro Service Centre for Farm Machinery.

DETAILED CONTENTS

1. Introduction (03 Periods)
Importance of farm mechanization. Classification of machinery & implements used on farm for raising crops.
2. Primary Tillage Equipment (05 Periods)
Introduction to various primary tillage implements, functions, constructional details, adjustments and study of different plough viz. mould board plough, disc plough, rotary tiller/ rotavator and chisel plough.
3. Secondary Tillage Implements (07 Periods)
Introduction to various secondary tillage implements. Study of cultivators & harrows, their types, functions & constructional details, clod crusher & planks
4. Seeding and Planting Equipment (12 Periods)
Introduction to various seeding and planting machinery for various crops. Study of components & functions of seed drills & planters; Concept of minimum tillage technology including zero till, strip till drill, raised bed planters and other conservation agriculture machinery.
Calibration of seed drills and planters.
5. Interculture Tools/Weeding Tools (04 Periods)
Introduction to various tools used for interculture, study of their functions and constructional details
6. Fertilizer/Manure Application Equipment (04 Periods)
Familiarization with the manure spreaders & granular fertilizer spreading equipment, study of their functions and importance.
7. Plant Protection and Plant Care (06 Periods)
Familiarization with various type of dusters and sprayers . Study of their

constructional details, function & principle of operation. Study of various types of the nozzles used in the sprayers and calibration of sprayers.

8. Harvesting and Threshing Machinery (16 Periods)
Familiarization with harvesting machines for various crops e. g. hay/forage harvesters, vertical conveyer reapers, cotton pickers, corn harvester, potato diggers, ground nut diggers, sugarcane harvesters Fruits and vegetables harvesting. Flail mowers Constructional details & principles of working. Study of power threshers including axial flow thresher - main components, function and constructional details. Safety requirements in threshing operations. Introduction to combine harvesters and straw combines and study of their operation and power transmission system. Losses during harvesting and threshing operations and their management.
9. Land Development Machinery (06 Periods)
Familiarization with various land development implements e.g. leveler including laser land leveler, land planer, scraper, ridger. Study of their functions and adaptability.
10. Miscellaneous Equipment (12 Periods)
Introduction to different equipment used for special operation e.g. puddlers, cage wheels, straw chopper, sub soiler, stubble stavers, straw field baler and densifiers. Introduction to various horticulture tools, post tool digger, tree pruners etc.
11. Economics of Equipment (07 Periods)
Field capacities, field efficiency, cost analysis and selection of farm machinery, BIS Standards of Farm Machinery and Specifications

LIST OF PRACTICALS

To study the constructional features and different components of the following agricultural implements/ farm machines:

1. Primary tillage implements: Mould board plough /Disc plough/sub soiler.
2. Secondary tillage implements: Harrow/Cultivators, Rotavators.
3. Sowing Machines: Seed Drill/Planter/Transplanter, zero-till, strip-till drill, bed planter, sugarcane planters, potato planter.
4. Interculture equipment/tools : Wheel hand hoe/Cultivators.
5. Harvesting Machines: Vertical Conveyer Reaper/Mower/Potato digger/ Groundnut Digger, Fail mowers
6. Threshing Machines: Wheat/paddy thresher, axial flow thresher, High capacity multicrop thresher.
7. Different types of sprayers and dusters, nozzles
8. Combine harvester and thresher.

Note: Emphasis should be laid on operation, maintenance, repair, safety and trouble shooting of farm machines and calibration of seeding machinery.

RECOMMENDED BOOKS

1. Element of Farm Machinery by A.C.Srivastava and Raju Primlari; Oxford &IBH Publishing Co. Pvt Ltd, New Delhi
2. Principle of Farm Machinery by R.A.Kepner , Roy Bainer, and E.H. Barger; CBS Publishers and Distributors, Delhi
3. Elements Of Agricultural Engineering Part 1 & 2 by Dr. O.P. Singhal and Naresh Chandra Aggarwal ; Mumfordganj, Allahabad
4. Principle of Agricultural Engineering Volume-I b y A.M. Michael & T.P.Ojha; Jain brothers.
5. Principle of Agricultural Engineering Volume-II b y A.M. Michael & T.P.Ojha ; Jain brothers.
6. Farm Power Machinery Volume-I by ISAE ; Jain brothers
7. Farm Power Machinery & Surveying by Irshad Ali ; Kitab Mahal, Nai Sarak, Delhi
8. Farm Machinery by Smith, HP
9. Tillage System in the Tropics by FAO; Oxford and IBH Publication Co.
10. Farm Machinery by Claude Culpin,

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	3	3
2	5	6
3	7	9
4	12	16
5	4	5
6	4	5
7	4	5
8	16	20
9	6	7
10	12	15
11	7	9
Total	80	100

