ENGINEERING MATHEMATICS III
SH 501

Lecture : 3 **Year : II**
Tutorial : 2 **Part : I**
Practical : 0

Course Objective:
The purpose of this course is to round out the students' preparation for more sophisticated applications with an introduction to linear algebra, Fourier Series, Laplace Transforms, integral transformation theorems and linear programming.

1. Determinants and Matrices (11 hours)
- 1.1. Determinant and its properties
- 1.2. Solution of system of linear equations
- 1.3. Algebra of matrices
- 1.4. Complex matrices
- 1.5. Rank of matrices
- 1.6. System of linear equations
- 1.7. Vector spaces
- 1.8. Linear transformations
- 1.9. Eigen value and Eigen vectors
- 1.10. The Cayley-Hamilton theorem and its uses
- 1.11. Diagonalization of matrices and its applications

2. Line, Surface and Volume Integrals (12 hours)
- 2.1. Line integrals
- 2.2. Evaluation of line integrals
- 2.3. Line integrals independent of path
- 2.4. Surfaces and surface integrals
- 2.5. Green's theorem in the plane and its applications
- 2.6. Stoke's theorem (without proof) and its applications
- 2.7. Volume integrals; Divergence theorem of Gauss (without proof) and its applications

3. Laplace Transform (8 hours)
- 3.1. Definitions and properties of Laplace Transform
- 3.2. Derivations of basic formulae of Laplace Transform
- 3.3. Inverse Laplace Transform: Definition and standard formulae of inverse Laplace Transform
- 3.4. Theorems on Laplace transform and its inverse
- 3.5. Convolution and related problems
- 3.6. Applications of Laplace Transform to ordinary differential equations

4. Fourier Series ` (5 hours)
- 4.1. Fourier Series
- 4.2. Periodic functions
- 4.3. Odd and even functions
- 4.4. Fourier series for arbitrary range
- 4.5. Half range Fourier series

5. Linear Programming (9 hours)
- 5.1. System of Linear Inequalities in two variables
- 5.2. Linear Programming in two dimensions: A Geometrical Approach
- 5.3. A Geometric introduction to the Simplex method
- 5.4. The Simplex method: Maximization with Problem constraints of the form "≤"
- 5.5. The Dual: Maximization with Problem Constraints of the form "≥"
- 5.6. Maximization and Minimization with mixed Constraints. The two-phase method(An alternative to the Big M Method)

References:

1. E. Kreszig, "Advance Engineering Mathematics", Willey, New York.
2. M.M Gutterman and Z.N.Nitecki, "Differential Equation, a First Course", 2nd Edition, saunders, New York.

Evaluation Scheme:

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

Chapters	Hours	Marks distribution*
1	11	20
2	12	20
3	8	15
4	5	10
5	9	15
Total	45	80

*There may be minor deviation in marks distribution.

ELEMENTS OF SOIL SCIENCE
AE 502

Lectures : 3 **Year : II**
Tutorial : 1 **Part : I**
Practical : 2

Course Objective:
To develop understanding about soil forming processes and soil as natural body/medium for storage and movement of water, gases, heat, nutrients and physical and chemical properties of soil.

1. Definition, Concept and Use of Soil: (2 hours)

1.1. Soils in relation to agricultural production
1.2. Concepts of land and soil
1.3. Definition and concept of soil science

2. Soil Forming Factors, Processes and Classification: (12 hours)

2.1. Soil forming rocks and minerals
2.2. Weathering of rocks and minerals
2.3. Soil profile: horizon designations
2.4. Morphological properties
2.5. Factors of soil formation
2.6. Major soil forming processes
2.7. Introduction and history of soil classification
2.8. Surface and sub-surface diagnostic horizons
2.9. Soil temperature regimes
2.10. Soil moisture regimes
2.11. Classification according to soil taxonomy
2.12. FAO/UNESCO system of soil classification
2.13. Soils of Nepal and their suitability for different purposes
2.14. Processes of soil survey and mapping

3. Physical Properties of Soils: (8 hours)

3.1. Soil color
3.2. Mechanical composition and textural classification
3.3. Soil structure
3.4. Bulk density, particle density and porosity
3.5. Soil consistency
3.6. Soil aeration
3.7. Soil moisture
3.8. Soil heat

4. Soil Physical Properties in Relation to Plant Growth (8 hours)

4.1. Soil moisture:
  4.1.1. quantitative concepts and measurements
  4.1.2. energy concepts and measurement
  4.1.3. soil moisture characteristics curves
  4.1.4. soil water movements (saturated and unsaturated)
  4.1.5. infiltration and percolation
  4.1.6. moisture extraction by plant roots
4.2. Soil aeration:
  4.2.1. significance
  4.2.2. composition
  4.2.3. mechanism of renewal
4.3. Soil temperature:
  4.3.1. energy balance
  4.3.2. soil thermal properties
  4.3.3. diurnal and seasonal variations
  4.3.4. significance

5. Soil Chemistry and Fertility (15 hours)

5.1. Soil reaction:
  5.1.1. acidic soils
  5.1.2. saline soils
  5.1.3. alkali soils
  5.1.4. soil amendments
  5.1.5. Soil colloids and their properties
5.2. Cation and anion exchange phenomenon
5.3. Macro and secondary plant nutrients:
  5.3.1. forms
  5.3.2. functions
  5.3.3. deficiency symptoms
  5.3.4. transformation
  5.3.5. availability to the plants
5.4. Introduction to micro nutrients and their significance in plant growth
5.5. Inorganic fertilizers:
  5.5.1. composition
  5.5.2. uses

5.5.3. behavior in soil

5.6. Soil fertility evaluation:
- 5.6.1. soil testing
- 5.6.2. plant analysis
- 5.6.3. deficiency symptoms
- 5.6.4. biological tests

5.7. Soil organic matters and organic manures

5.8. Green manuring and biofertilizers

Practical:

1. Identification of important rocks and minerals
2. Collection and preparation of soil samples
3. Determination of soil texture and consistency by feel method
4. Identification of soil structure
5. Determination of bulk density, particle density, total porosity and air porosity
6. Particle size analysis by hydrometer method
7. Determination of aggregate size distribution
8. Study of soil profile and morphological properties
9. Determination of soil moisture content by weight and volume
10. Measurement of soil moisture by metric suction
11. Measurement of soil moisture by electrical resistance method (use of soil moisture Meter)
12. Observation of capillary phenomenon in soil
13. Determination of hydraulic conductivity
14. Determination of infiltration characteristics of soils
15. Use of soil testing kit
16. Determination of organic matter in soils
17. Determination of soil pH and electrical conductivity
18. Estimation of available nitrogen, phosphorous and potassium
19. Identification of nutrient deficiency symptoms of major crops

References:

1. Nyle C. Brady. The Nature and Properties of Soils. 10th edition. Prentice Hall of India Ltd.
2. Biswas T.D. and S.K. Mukharjee. A Textbook of Soil Science. Tata McGraw Hill Publications
3. Oswal M.C. Soil Physics. Oxford and IBH Publishing Co. New Delhi
4. Gupta. P.K. Soil, Plant , Water and Fertilizer Anlysis. Agrobios (India)

Evaluation system:

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

Chapters	Hours	Marks distribution*
1	2	4
2	12	20
3	8	14
4	8	14
5	15	28
Total	**45**	**80**

*There may be minor variation in marks distribution

FLUID MECHANICS
CE 505

Lecture : 3 **Year : II**
Tutorial : 2 **Part : I**
Practical : 1

Course Objective:

A proper understanding of fluid mechanics is extremely important in many areas of civil engineering. This course has been designed to provide basic knowledge of fluid mechanics to the students of civil engineering so that it would be helpful them to understand the basic phenomena of this science. This course shall be considered as an introduction: common for all civil engineering faculties of Tribhuvan University in the second year first part of undergraduate.

1. Fluid and its physical properties (3 hours)

1.1 Basic concept and definition of fluid. Application in civil engineering
1.2 Shear stress in a moving fluid, Difference between solids and fluids
1.3 Concept of control volume and continuum in fluid mechanics
1.4 Mass density, specific weight, specific gravity, specific volume, viscosity, compressibility, capillarity, surface tension, cavitation and vapour pressure (relations, their dimension, units as well as values for different materials).
1.5 Newton's law of viscosity causes of viscosity in liquid and gases.
1.6 Variation of viscosity with temperature for different fluids
1.7 Different methods for finding viscosity of fluids like viscometer etc.
1.8 Ideal and Real fluid, Newtonian and non Newtonian, compressible and incompressible fluid with examples

2. Pressure and Head (4 hours)

2.1 Introduction, application in civil engineering. Concept about the absolute and relative equilibrium.
2.2 Atmospheric, gauge and absolute pressure
2.3 Hydrostatics law of pressure distribution (pressure depth relationship)
2.4 Pascal's law
2.5 Measurement of pressure, simple manometer as piezometer, U-tube manometer, single column vertical and inclined manometers, differential manometer, inverted U-tube differential manometer, bourden gauge

3. Hydrostatics (10 hours)

3.1 Pressure force and centre of pressure on submerged bodies (plane and curve Surfaces)
3.2 Computation of pressure forces on gates (plane and curve), dams, retainingstructures and other hydraulic structures, pressure diagrams
3.3 Buoyancy, flotation concept, thrust on submerged and floating bodies, hydrometer
3.4 The stability of floating and submerged bodies.
3.5 Metacentre, determination of metacentric height.
3.6 Liquid in relative equilibrium (pressure variation in the case of uniform linear and radial acceleration)
3.7 Computer programme coding for simple problems

4. Hydrokinematics (4 hours)

4.1 Lagragian and Eulerain approaches of describing fluid flow
4.2 One, two and three dimensional of flow
4.3 Classification of fluid motion (uniform and non-uniform, steady and unsteady, laminar and turbulent flows)
4.4 Rotational and Irrotational motion, stream function and potential function.
4.5 Description of streamline, streak line, path line and stream tube and their drawing procedures
4.6 Conservation principle of mass and continuity equation in Cartesian and cylindrical polar coordinates (one , two and three dimensional)

5. Hydrodynamics (2 hours)

5.1 Forces acting on a fluid in motion (gravitational, pressure, viscous, turbulent, surface tension, and compression forces)
5.2 Reynolds's, Euler's and Navier-Stoke's equation of motions
5.3 Development of the Euler's Equation of motion
5.4 Bernoulli's equation and its physical meaning

6. Flow measurement (7 hours)

6.1 Venturimeter, orifice meter nozzle meter and Pitot tube

6.2 Flow through orifice (small orifice, large orifice, partially submerged orifice as well as submerged orifice)
6.3 Different hydraulic coefficients Cv, Cc and Cd) and their determination
6.4 Notches and Weir (classification, discharge through rectangular, triangular trapezoidal , and Cipoletti notches, Sharp crested weir, narrow crested weir, broad crested as well as ogee shaped weirs)
6.5 Emptying and filling of reservoirs without inflow (cylindrical, hemispherical and conical). Emptying and filling of reservoir with inflow (cylindrical case).
6.6 Computer programme coding for simple problems

7. Momentum principle and flow analysis (6 hours)

7.1 Momentum principle and equations
7.2 Application of equation of calculate forces (pipe in bends, enlargements and reducer)
7.3 Forces exerted by the jet on stationary and moving vanes of different shapes
7.4 Concept of angular momentum with examples.

8. Boundary Layer theory (3 hours)

8.1 Boundary layer concept and definition.
8.2 Boundary layer concept along a thin plate (laminar zone, turbulent zone, transition zone as well as laminar sub layer)
8.3 Application of this concept (hydraulically smooth and rough boundary)
8.4 Boundary layer thickness (Boundary layer thickness, momentum thickness, and is placement thickness)

9. Flow past through submerged bodies (3 hours)

9.1 Introduction to the drag and lift forces acting on a body
9.2 Expression for drag and lift forces
9.3 Pressure and friction drag; drag coefficients
9.4 Drag on a flat plate, cylinder and sphere
9.5 Concept of aerofoil.

10. Similitude and physical modeling (3 hours)

10.1 Introduction to dimensional analysis (physical quantities and their dimensions)
10.2 Methods of dimensional analysis (Rayleigh and Buckingham theorem)
10.3 Similitude, laws of similarity, distorted and undistorted model Physical model and modeling criteria (Reynolds, Froude, Euler, Weber and Mach's model laws with some examples.)

Practical:

The following exercises will be performed in this course. These are:

1. Hydrostatic force on submerged body
2. Stability of a floating body
3. Verification of Bernoulli's equation
4. Impact of jet
5. Flow through edged orifice
6. Flow over broad-crested weir

Tutorials:

There shall be related tutorials exercised in class and given as regular homework exercises. Tutorials can be as following for each specified chapters.

1. Physical Properties of Fluids (2 hours)
- Practical examples, numerical examples

2. Pressure and Head (3 hours)
- Practical examples, numerical examples and derivation type questions

3. Hydrostatics (6 hours)
- There will be tutorial for each sub-section
- Use of computer programme (studied in I/I) for solving exercises

4. Hydrokinematics (2 hours)
- Practical examples, numerical examples and derivation type questions

5. Hydrodynamics (3 hours)
- Practical examples, numerical examples and derivation type questions

6. Flow measurements (4 hours)
- Practical examples, numerical examples and derivation type questions
- There will be tutorial for each sub-section

- Use of computer programme (studied in I/I) to solve some problems

7. Momentum principle and flow analysis (3 hours)

- Practical examples, numerical examples and derivation type questions
- There will be tutorial for each sub-section
- Use of computer programme (studied in I/I) to solve some problems

8. Flow past submerged bodies (2 hours)

- Practical examples, numerical examples and derivation type questions

9. Boundary layer theory (2 hours)

- Practical examples, numerical examples and derivation type questions

10. Similitude and physical modeling (2 hours)

- Practical examples, numerical examples and derivation type questions

Chapters	Hours	Marks distribution*
1	3	6
2	4	6
3	10	15
4	4	6
5	2	4
6	7	12
7	6	8
8	3	7
9	3	8
10	3	8
Total	45	80

*There may be minor variation in marks distribution

References:

1. "Fluid Mechanics for Civil Engineers", Webber, N.B. 1995, Chapman and Hall.
2. Victor and street, "Elementary fluid mechanics", sixth edition, John wiley and sons inc. 605, third avenue, Newyork
3. D.S. Kumar "Fluid Mechanics and Fluid power Engineering" S.K. Kataria and Sons, sixth edition, 2005
4. K. L. Kumar "Engineering Fluid Mechanics", , Eurasia Publishing house (P) Ltd. Ram Nagar New Delhi, 2000.
5. Hydraulics fluid mechanics and fluid machines, S Ramamrutham. Dhanpat Rai Publishing Company (P) Ltd. New Delhi Seventh Edition 2006
6. Fundamentals of Fluid Mechanics, D. P.Sangroula, Nepal Printing Support, Anamnager, Kathmandu, 2008

Evaluation Scheme:

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

ENGINERING MATERIAL
AE 503

Lecture : 2 **Year : II**
Tutorial : 0 **Part : I**
Practical : 3/2

Course objective:

After completion of this course, student wil be familiar about the fundamental properties of construction material.

1. Introduction
- 1.1 Scope of the subject
- 1.2 Type of building material
- 1.3 Physical properties of material
- 1.4 Mechanical properties of material
- 1.5 Thermal properties of material
- 1.6 Other properties of material

2. Metals
- 2.1 Introduction
- 2.2 Categorization of metals – ferrous and non ferrous
- 2.3 Short description of Ferrous metals:- pig iron, cast iron, wrought iron and steels
- 2.4 Short description of Non-Ferrous metals- Aluminum
- 2.5 Different steel alloys and their uses
- 2.6 Defects in steel
- 2.7 Mechanical treatment of steel

3. Properties of steel
- 3.1 Microstructure examination of steel
- 3.2 Elastic and plastic behavior of metals
- 3.3 Ductility, resilience and stiffness of steel
- 3.4 Hardness and toughness of steel
- 3.5 Other mechanical properties
- 3.6 Deformation of steel
- 3.7 Stress strain relationship
- 3.8 Modulus of elasticity and Poisson's ratio
- 3.9 Effect of repetitive and dynamic forces on steel
- 3.10 Corrosion and its prevention
  - 3.10.1 Introduction
  - 3.10.2 Factors influencing corrosion
  - 3.10.3 General types of corrosion
  - 3.10.4 Control and Prevention of corrosion
- 3.11 Heat treatment of steel
- 3.12 Fracture modes of metal

4. Wood
- 4.1 Definition
- 4.2 Classification of trees
- 4.3 Soft wood and hard wood
- 4.4 Physical, mechanical and thermal properties of timber **(3 hourss)**
- 4.5 Defects in timber
- 4.6 Seasoning of timber
- 4.7 Commercial forms of wood
- 4.8 Fracture modes of timber
- 4.9 Properties of a good timber
- 4.10 Advantages and disadvantages of wood

5. Ceramic materials (4 hours)
- 5.1 Introduction
- 5.2 Composition of break earth
- 5.3 Physical and mechanical properties of brick
- 5.4 Types of tiles
- 5.5 Physical and mechanical properties of tiles
- 5.6 Introduction to sand and aggregate
- 5.7 Test on:
  - 5.7.1 Sand: Bulking of sand, clay content and fineness modulus
  - 5.7.2 Aggregates: Loss Angeles abrasion test
- 5.8 Glasses **(12 hours)**
  - 5.8.1 Classification of glass
  - 5.8.2 Properties and uses of glass

6. Cementing materials
- 6.1 Definition
- 6.2 Lime:
  - 6.2.1 Introduction, properties and use of lime
  - 6.2.2 Types of lime
  - 6.2.3 Slaking of lime
- 6.3 Cement
  - 6.3.1 Introduction

6.3.2 Ingredients of cement and their functions
6.3.3 Harmful constituents of cement
6.3.4 Composition of cement clinker
6.3.5 Introduction to types of Cement
6.3.6 Tests on cement – Consistency test, setting time test, fineness test and compressive strength test

7. Asphalt, Bitumen and Tar **(6 hours)**

7.1 Asphalt
7.1.1 Definition, properties in use of Asphalt
7.1.2 Types of Asphalt
7.1.3 Forms of Asphalt
7.2 Bitumen
7.1.4 Definition, properties and its uses
7.1.5 Forms of Bitumen
7.3 Tar
7.1.6 Definition, properties and its uses
7.1.7 Types of Tar
7.4 Definition and use of Pitch
7.5 Comparison between asphalt, bitumen and tar
7.6 Test on bitumen – penetration test, softening point test, viscosity test and ductility test

8. Synthetic polymers **(3 hours)**

8.1 Definition
8.2 Basic types of polymer
8.3 Properties of polymer
8.4 Use of polymers in construction and maintenance works

Practical:

1. Microstructure examination of mild steel, alloy steel, aluminum alloy, cast and wood, using optical microscope
2. Hardness on mild steel, cast iron and alloy steel
3. Toughness test on mild steel, cast iron and alloy steel
4. Fracture mechanics of wood
5. Test on bitumen – Penetration test, softening point test, ductility test and viscosity test
6. Test on ceramics:
   Brick – Compressive strength and water absorption test;
   Sand – Clay content, bulking of sand and fiteness modulus test;
   Aggregate – los Angeles abrasion test; and
   Cement – Consistency test, compressive strength test, fitness test, and setting time test

Reference:

1. S.C.Rangawala, “Engineering Materials” Charotar Publication
2. K.P Roy Chaudhary, “ Engineering Materials” Oxford and IBH Publication
3. Peter A. Thornton and Vito J. colangela, "Fundamentals of engineering materials"
4. Sushil Kumar, "Engineering material", Standard publication

Evaluation Scheme:

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

Chapters	Hours	Marks distribution*
1	3	5
2	4	8
3	12	20
4	5	10
5	6	12
6	6	10
7	6	10
8	3	5
Total	**45**	**80**

*There may be minor variation in marks distribution

FARM POWER AND ENGINE SYSTEMS
AE 501

Lectures : 3 **Year : II**
Tutorial : 1 **Part : I**
Practical : 2

Course Objective:
After completion of this course the students will be able to understand the concept of prime sources of farm power and fundamentals of internal combustion engines.

1. Animate and Inanimate Sources of Farm Power (10 hours)
- 1.1 Sources of Farm Power and their Utilization
  - 1.1.1 Human Power
  - 1.1.2 Animal Power
  - 1.1.3 Electrical Power
  - 1.1.4 Mechanical Power
  - 1.1.5 Solar Energy
  - 1.1.6 Wind Energy
  - 1.1.7 Bio-gas
  - 1.1.8 Micro-Hydro
- 1.2 Availability, Advantages and Limitations of Farm Power Sources
- 1.3 Account of Farm Power Sources in Nepal
- 1.4 Animal Power Harnesses
  - 1.4.1 Measurement of Animal Power
  - 1.4.2 Yokes and Harnesses for Draught Animals for
    - 1.4.2.1 Walking Type Farm Machines and Equipment
    - 1.4.2.2 Riding Type Farm Machines and Equipment
    - 1.4.2.3 Transport Equipment
- 1.5 Mechanics of Hitching
- 1.6 Design Parameters for Animal Harnesses

2. Internal Combustion Engines (8 hours)
- 2.1 Operational Parameters of Internal Combustion Engines
- 2.2 Classification of Internal Combustion Engines
- 2.3 Working Cycles of Internal Combustion Engines
- 2.4 Two-Stroke and Four Stroke Cycle Engines
- 2.5 Spark Ignition and Compression Ignition Engines
- 2.6 Engine Components and Their Construction
- 2.7 Firing Order and Criteria for Selection of Firing Order

3. Performance of Internal Combustion Engines (8 hours)
- 3.1 Indicated Power, Brake Power, Mean Effective Pressure
- 3.2 Engine Efficiency
- 3.3 Heat Balance for Internal Combustion Engines
- 3.4 Power, Torque, Speed Relationship
- 3.5 Specific Fuel Consumption

4. Operating Principle and Function of Engine Systems

4.1 Valve Operating System (4 hours)
- 4.1.1 Valve Arrangement
- 4.1.2 Components Involved in Valve Operation
- 4.1.3 Cam Profile and Valve Lift
- 4.1.4 Size of Valve Ports and Valve Opening Area
- 4.1.5 Valve Timing
- 4.1.6 Valve Clearance
- 4.1.7 Valve Adjustment and Maintenance

4.2 Intake and Exhaust System (3 hours)
- 4.2.1 Air Cleaning System and Types
- 4.2.2 Performance of Different Air Cleaners
- 4.2.3 Components Involved in Exhaust System
- 4.2.4 Maintenance of Intake and Exhaust System

4.3 Engine Fuels and Fuel Supply System (8 hours)
- 4.3.1 Properties of Fuels used in I.C. Engines
- 4.3.2 Calorific and Heating Values of Fuels
- 4.3.3 Octane and Cetane Rating
- 4.3.4 Test of Gasoline and Diesel Fuel
- 4.3.5 quations for Hydrocarbon Fuels
- 4.3.6 Combustion in Spark Ignition and Compression Ignition Engines
- 4.3.7 Air-Fuel Ratio and Mixture Requirements
- 4.3.8 Carburetion and Working Principle of Carburetor
- 4.3.9 Working Principle and Components of Diesel Fuel Supply System
- 4.3.10 Working Principle and Components of Petrol Fuel Supply System

4.4 Ignition System (3 hours)
- 4.4.1 Ignition Timing

4.4.2 Pre-Ignition and Ignition Delays
4.4.3 Detonation and Knocking in I.C. Engines
4.4.4 Ignition Advance and Retard
4.4.5 Ignition Trouble Shooting and Remedies

4.5 Governor and Governor Control (2 hours)

4.5.1 Purpose
4.5.2 Types and Working Principle
4.5.3 Stability, Hunting, Regulation and Sensitivity
4.5.4 Troubles and Remedies

4.6 Cooling System (3 hours)

4.6.1 Purpose and Types of Cooling System
4.6.2 Heat Balance
4.6.3 Components of Air Cooling System
4.6.4 Components of Pressure Water Cooling System
4.6.5 Corrosion and Corrosion Inhibitors
4.6.6 Cooling System Tune-up
4.6.7 Antifreeze Mixture

4.7 Lubrication System (5 hours)

4.7.1 Purpose of Engine Lubrication
4.7.2 Lubricating Oil Classification
4.7.3 Properties of Lubricants
4.7.4 Additives in Lubricating Oil and Pollution
4.7.5 Selection Parameters of Lubricating Oil
4.7.6 Components of Pressure Feed Lubrication System
4.7.7 Maintenance of Lubrication System

4.8 Starting and Electrical System (3 hours)

4.8.1 Components of Self-Starting System
4.8.2 Storage Battery Maintenance
4.8.3 Lighting and Horn
4.8.4 Maintenance of Electrical System

4.9 Small Engines for Farm Operations (3 hours)

4.9.1 Stationary Engines for Farm Operations
4.9.2 Range and Availability in the Country
4.9.3 Selection of Engines for Farm Operations

Practical:

1. Dismantling of an Internal Combustion 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 Internal Combustion Engines
7. Study on Lubrication System in Internal Combustion Engines
8. Study on Governors and Governing System in Internal Combustion 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

References:

1. Willard W.Pulkrabek ,“Engineering Fundamentals of the Internal Combustion Engine”, Prentice-Hall of India Pvt. Ltd., New Delhi, India.
2. Ganesan, “Internal Combustion Engines”, Tata McGraw-Hill Publishing Company Limited, New Delhi, India.
3. M. L. Mathur and P. Sharma. Dhanpat Rai & Sons, “Internal Combustion Engines” New Delhi, India.
4. J. B. Liljedahl, P. K. Turnquist, D. W. Smith and M. Hoki “Tractors and Their Power Units”, CBS Publishers and Disbuters, New Delhi, India.
5. T. P. Ojha and A. M. Michael. Jain Brothers, “Principles of Agricultural Engineering, Vol I” ,New Delhi, India.
6. Ben D. Moses and Nenneth R. Frost. John Wiley & Sons “Farm Power”, New York, USA.

Evaluation Scheme:

The questions will cover all the chapters of the syllabus. The evaluation for the final theory examination is indicated as follows:

Chapters	Hours	Marks distribution*
1	10	12
2	8	10
3	8	10
4.1 & 4.2	7	10
4.3	8	10
4.4 & 4.6	6	9
4.5 & 4.7	7	10
4.8 & 5	6	9
Total	**60**	**80**

*There could be minor variation in marks distribution

REFRIGERATION AND COLD STORAGE
ME 506

Lecture : 3 **Year : II**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objective:
To develop basic concept and fundamental knowledge of air compressor, refrigeration system, psychrometry and cold storage

1. Thermodynamic Cycles (4 hours)
- 1.1 Carnot Cycle for Refrigeration
- 1.2 Reverse Carnot Cycle
- 1.3 Conclusion from Carnot Cycle
- 1.4 Refrigerator and Heat Pump
- 1.5 Coefficient of Performance (COP)

2. Reciprocating Air Compressor (8 hours)
- 2.1 Air Compressor Terminology
- 2.2 Primary Components of a Reciprocating Air Compressor
- 2.3 Working Principle of Reciprocating Air Compressor
- 2.4 Work Done by Compressor
- 2.5 Volumetric and Adiabatic Efficiencies
- 2.6 Multi-stage Compression
- 2.7 Intercoolers
- 2.8 Representation of p-V and T-s diagrams
- 2.9 Clearance Volume Effects
- 2.10 Condition for Minimum Work

3. Other Compressors (6 hours)
- 3.1 Rotary Compressors
- 3.2 Hermetic Sealed Compressors
- 3.3 Centrifugal Compressors
- 3.4 Axial flow Compressors
- 3.5 Power Required to Drive a Compressor
- 3.6 Velocity Diagrams
- 3.7 Losses and Efficiencies of compressors
- 3.8 Application of Compressors

4. Refrigeration System (8 hours)
- 4.1 Introduction
- 4.2 Unit of Refrigeration
- 4.3 Air Refrigeration System
- 4.4 Simple Vapour Compression Refrigeration System: Ideal and Actual Vapour Compression Cycles, T-s and p-h Diagrams, Effects of Dry Compression and Wet Compression, Coefficient of Performance
- 4.5 Multi-Stage Refrigeration System
- 4.6 Cascade Refrigeration System
- 4.7 Vapour Absorption Refrigeration System: Vapour Absorption Cycle,
- 4.8 Electrolux Refrigerator

5. Evaporators: Types, Function, Capacity of an Evaporator, Factors Affecting the Heat Transfer Capacity (4 hours)

6. Condensers: Types, Function, Factors Affecting the Condenser Capacity, Heat Rejection Factor, Cooling Towers and Spray Ponds (4 hours)

7. Expansion Devices: Types, Construction and Functions. (2 hours)

8. Refrigerants (6 hours)
- 8.1 Classification
- 8.2 Properties: Ideal, Physical and Chemical
- 8.3 Environment Friendly Refrigerants

9. Principle of Psychometrics (10 hours)
- 9.1 Psychrometric Properties
- 9.2 Phychometric Processes
  - 9.2.1 Sensible Heating and Cooling
  - 9.2.2 Cooling and Dehumidification
  - 9.2.3 Heating and Humidification
  - 9.2.4 Humidification and Dehumidification
  - 9.2.5 Mixing of Two Streams of Air
  - 9.2.6 Evaporative Cooling/ Adiabatic Humidification
- 9.3 Phychrometric Chart and Its Use
- 9.4 Comfort Conditions
- 9.5 Air-conditioning Systems

10. Cold Storage (8 hours)

10.1 Introduction
10.2 Functional Requirements of Cold Storage
10.3 Condition of Storage for Perishable Products
10.4 Calculation of Cooling Load
10.5 Design of Cold Storage System

Practical:

1. Studies on Parallel Flow and Counter Flow Heat Exchangers
2. Performance Evaluation of Reciprocating Air-Compressor
3. Study on Components and Processes of Vapour Compression and Vapour Absorption Type Refrigeration System
4. Determination of Coefficient of Performance of Vapour Compression and Vapour Absorption Type Refrigeration System
5. Experimentation on Refrigeration Tutor, Humidifier and Heat Pump to Determine Coefficient of Performance and Efficiency
6. Calculation of Cooling Loads
7. Determination of Heat Transfer Coefficient inside a Cold Storage and Refrigerator.
8. Determination of Pull Down Characteristics of a Cold Storage.

References:

1. C. P. Arora, "Refrigeration and Air-Conditioning", Tata McGraw Hill Book Co. Ltd, New Delhi, India.
2. Manohar Prasa, "Refrigeration and Air-Conditioning", Wiley Eastern Publishers, New Delhi, India.
3. Roy J. Dossat, "Principles of Refrigeration",. Wiley Eastern Publishers, New Delhi, India.
4. McQuistion and W. Tauker, "Heating, Ventilation and Air-Conditioning",Wiley Eastern Publishers, New Delhi, India.

Evaluation Scheme:

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

Chapters	Hours	Marks distribution*
1	4	5
2	8	10
3	6	8
4	8	10
5,6,7	10	13
8	6	10
9	10	12
10	8	12
Total	60	80

*There may be minor deviation in marks distribution.

ELECTRIC SYSTEMS AND MACHINES
EE 503

Lecture : 3 **Year : II**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objective:
After completion of this course the student will be able to understand the fundamentals of electrical supply, measurement, safety, protection and machines.

1. Introduction to supply and distribution (6 hours)
- 1.1 Introduction to electrical supply & distribution
- 1.2 Introduction to electrical installation
- 1.3 Wiring material and accessories
- 1.4 Control & protection
- 1.5 Earthing of installation

2. Electrical measurements (2 hours)
- 2.1 Introduction
- 2.2 Electrical measuring instruments

3. Electrical maintenance & safety (4 hours)
- 3.1 Electric shocks, effect & precaution
- 3.2 Electrical maintenance and care
- 3.3 Safe use of electricity

4. Electromagnetism (4 hours)
- 4.1 Introduction
- 4.2 Magnetic field due to electric current
- 4.3 Force on current carrying conductor
- 4.4 Force between parallel conductor
- 4.5 Torque experienced by the coil
- 4.6 Electromagnetic induction
- 4.7 Statically & Dynamically induced EMF

5. Magnetic circuits (3 hours)
- 5.1 Introduction
- 5.2 Magneto motive force
- 5.3 Magnetic circuit theory
- 5.4 Self & mutual inductance

6. Transformer (7 hours)
- 6.1 Introduction
- 6.2 Working principle of transformer
- 6.3 Transformer construction
- 6.4 Types of transformer
- 6.5 Transformer at load and no load condition
- 6.6 Voltage regulation of a transformer
- 6.7 Types of losses and Efficiency of a transformer
- 6.8 Three-phase transformer

7. Generators (6 hours)
- 7.1 Introduction
- 7.2 Construction of generator
- 7.3 Operating principle of generator
- 7.4 EMF equation
- 7.5 Types of generator
- 7.6 Uses of different types of generator
- 7.7 Generator ratings
- 7.8 Diesel generator set use and maintenance

8. D.C. motors (4 hours)
- 8.1 Introduction
- 8.2 Working principle of d.c. motor
- 8.3 Construction of d.c. motor
- 8.4 Types of d.c. motor and their uses
- 8.5 D.C. motor connection

9. A.C. motors (5 hours)
- 9.1 Introduction
- 9.2 Operating principle of induction motor
- 9.3 Construction of induction motor
- 9.4 Connection for starting, reversing and speed changing of 3-phase induction motor
- 9.5 Methods of power factor improvement
- 9.6 Synchronous motors

10. Single phase motors (2 hours)

10.1 introduction
10.2 AC series motor
10.3 Universal motor
10.4 Stepper motor
10.5 Application of single phase motors

11. Selection of Electric motors (2 hours)

11.1 Electric Characteristics
11.2 Types of Enclosures
11.3 Size and Ratings
11.4 Estimation of Motor Ratings

Practical:

1. Load test on a single phase transformer

1.1 To determine the polarity of the primary and secondary winding
1.2 To find the turns-ratio
1.3 To determine the efficiency at different loads
1.4 To determine the voltage regulation

2. Open circuit and short circuit test on a single phase tansformer

2.1 To find efficiency at various load
2.2 To find the load at which efficiency is maximum
2.3 To calculate the voltage regulation at full load at p.f. i) 0.85 lagg and ii) 0.85 lead.

3. Study of constructional details and starting of d.c. machine

3.1 To study the constructional features of a d.c. machine
3.2 To measure winding resistance
3.3 To start and reverse the direction of the rotation of a d.c. motor

4. Speed control of a d.c. shunt motor

4.1 To plot the speed versus field current characteristics curve for a d.c shunt motor
4.2 To plot the speed versus armature voltage characteristics curve for a d.c. shunt motor

5. Three-phase induction motor starter

5.1 To study the various types of three-phase induction motor starter
5.1.1 Auto-transformer starter
5.1.2 Star-delta starter
5.1.3 DOL starter

6. Load test on three phase induction motor

6.1 Compute, torque, output power, input power, efficiency, input power factor and slip for various load settings
6.2 To plot the following curves from the data obtained in part (6.1)
6.2.1 Efficiency vs output power
6.2.2 Torque vs output power
6.2.3 Line current vs output power
6.2.4 Power factor vs output power
6.2.5 Slip vs output power

References

1. D.C. Kulshreshtha "Basic Electrical Engineering" Tata McGraw Hill Private limited, New Delhi 2010
2. B.R.Gupta & Vandana Singhal " Fundamentals of Electric Machines" New age international publishers, New Delhi 2005
3. Dr. N.K. Jain " A text book of practical in Electrical Engineering", Dhanpat Rai Publishing Company,New Delhi 2002

Evaluation Scheme:

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

Chapters	Hours	Marks distribution*
1	**6**	**12**
2 & 3	**6**	**12**
4 & 5	**7**	**12**
6	**7**	**12**
7	**6**	**8**
8	**4**	**8**
9	**5**	**8**
10 & 11	**4**	**8**
Total	**45**	**80**

*There may be minor deviation in marks distribution.

SURVEYING & LEVELING
CE 559

Lecture : 3 **Year : II**
Tutorial : 0 **Part : II**
Practical : 4

Course Objective:
In order to develop the sound knowledge in the surveying field of the students related to BE Agri. Engineering, this course has been designed.

1. Introduction (2 hours)

1.1 History of surveying
1.2 Classification of surveying
1.3 Principles used in surveying

2. Survey measurements, field and office work (4 hours)

2.1 Introduction, units and system of measurements, Types of measurements, Significant figures, Rounding of numbers, Scales
2.2 Accuracy and precision
2.3 Errors in measurements, sources of errors and types of errors
2.4 General Planning and Design of Survey
  2.4.1 Specification
  2.4.2 Collection of existing map, documents, slides and control points
  2.4.3 Selection of equipments and survey procedure, selection of computational procedures and method of data presentation
2.5 Care and handling of instruments, Adjustment of the instruments, Recording of field notes, Note Books, Data Recording, Other media for data recording, cross checking, Computational etc.

3. Linear Distance Measurements (2 hours)

3.1 Distance by Pacing, Taping, Triangulation, Tacheometry, EDM, Total Station, GPS
3.2 Instruments and Methods of Measurements
3.3 Tape correction (Standardization, Tension, Temperature, Sag, Slope)
3.4 Principle of Electronic Distance Measurement

4. Vertical Distance Measurements: Leveling (8 hours)

4.1 Definition, Requirements of vertical measurements , Principles of leveling (Direct/ Spirit leveling, Trigonometric Leveling, Barometric leveling)
4.2 Leveling Instruments, Levels (Dumpy, Tilting, Auto, Digital), Leveling staves, Foot plates, Rod levels
4.3 Temporary and Permanent adjustment of level (Two peg test and collimation correction)
4.4 Booking and calculation of reduced level (HI method, Rise/Fall method)
4.5 Classification of leveling
  4.5.1 Fly leveling
  4.5.2 Profile leveling
  4.5.3 Cross sectioning
  4.5.4 Reciprocal leveling
4.6 Curvature and refraction
4.7 Errors, Adjustment of level circuit
4.8 Introduction of grades or slopes in leveling and setting out of grade stakes as per grade elevation
4.9 Field problems

5. Angles and Directions Measurements (6 hours)

5.1 Location of points, Meridians, True meridian, Magnetic meridian, Grid meridian, Angles and directions, Bearings, Interior angles, Deflection angles, Angle to the right
5.2 Methods of determining angles and directions
5.3 Magnetic compass (Prismatic, Surveyor's and other analogue and digitized compass)
5.4 Magnetic declination, Local attraction, detection and elimination of local attraction
5.5 Use of compass
5.6 Theodolites, Level tubes, Telescope, Graduated circle, Geometry of the theodolites, Different types of theodolites
5.7 Methods of measuring horizontal angles by using different types of theodolites
5.8 Measurement of vertical and zenithal angles.
5.9 Laying of horizontal angles

5.10 Errors and corrections
5.11 Field Problems

6. Traverse (8 hours)

6.1 Introduction, Traverse party, Equipment for traverse party, Purpose of traverse, Types of traverse and methods of traversing
6.2 Field works for traversing, traverse field notes
6.3 Traverse computation for closed traverse and link (closed loop) traverse
  6.3.1 Reduction of reading to angles and balancing of angles
  6.3.2 Computation of bearing and adjustment of bearing
  6.3.3 Computation of latitude and departure
  6.3.4 Balancing of consecutive coordinates
  6.3.5 Computation of independent coordinates and plotting of traverse
6.4 Methods of determining area: Area by triangles, coordinates, double meridian distances and latitudes, Simpson's one third rule, Trapezoidal rule
6.5 Traverse omitted measurements
6.6 Field problems

7. Stadia and Tacheometry (4 hours)

7.1 Definition, Principle of stadia tachoemetry
7.2 System of tacheometric measurements
7.3 Principles of stadia system, Distance and Elevation for inclined sight with staff vertical, Determination of multiplying constant and additive constant, Introduction of subtense bar and self reducing tacheometer
7.4 Accuracy and precision of tacheometric survey
7.5 Field problems

8. Topographic Survey (4 hours)

8.1 Introduction, methods of topographic survey, control for topographic survey
8.2 Contours, Characteristics of contours, Direct and Indirect method for locating contours
8.3 Interpolation of contours
8.4 Basic field methods for locating topographic details

9. Triangulation and Trilateration: Introduction (1 hour)

10. Analytical Intersection and Resection (2 hours)

11. Introduction of simple circular curve (1 hour)

12. Introduction to Global Positioning System (GPS) (2 hours)

12.1 Principles of GPS, Components of GPS, accuracy and errors
12.2 Differential GPS, GPS application, Absolute GPS

13. Aerial Photogrammetry: Introduction, application and limitation (1 hour)

Practical:

1. Horizontal distance measurement in plane and sloping ground
2. Two peg test and fly leveling
3. Profile and cross sectioning
4. Traversing by using prismatic compass
5. Traversing using theodolite
6. Traverse computation and plotting
7. Tacheometric detailing for topographic survey
8. Plotting of topographic map/parcellary map preparation
9. Demonstration of GIS software and GPS unit

References:

1. A Banister and S Raymond - Surveying- English Language Book Society (ELBS), Latest Edition
2. Punmia B.C. - Surveying, Khanna Publication, New Delhi - Latest Edition
3. R. Agor – Surveying and Levelling
4. Basak N N – Surveying and Levelling
5. Duggal S K – Surveying
6. Roy S K – Surveying
7. Saikia M D – Surveying

Evaluation Scheme:

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

Chapters	Hours	Marks distribution*
1	2	6
2	4	6
3	2	6
4	8	12
5	6	12
6	8	14
7	4	6
8	4	6
9,10,11	4	6
12,13	3	6
Total	**45**	**80**

*There may be minor variation in marks distribution

PRINCIPLES OF CROP SCIENCE AND MANAGEMENT
AE 552

Lectures : 4 **Year : II**
Tutorial : 0 **Part : II**
Practical : 3/2

Course Objective:

To develop basic understanding about efficient crop management and skills about crop cultivation practices with diseases and pest management

Part-I Agronomy

1. Definition, Scope and Importance (2 hours)
- 1.1 Definition and relationship with other sciences
- 1.2 Scope and importance
- 1.3 Classification of agronomical crops

2. Review of Crop Physiological Processes (4 hours)
- 2.1 Germination
- 2.2 Uptake of water and nutrients
- 2.3 Photosynthesis
- 2.4 Respiration
- 2.5 Transpiration
- 2.6 Growth
- 2.7 Development
- 2.8 Flowering
- 2.9 Fruiting
- 2.10 Senescence

3. Effect of Weather Elements on Crop Production (3 hours)
- 3.1 Solar radiation
- 3.2 Temperature
- 3.3 Humidity
- 3.4 Wind
- 3.5 Rainfall
- 3.6 Agro-climatic requirements of major food crops
- 3.7 Climatic hazards and their management

4. Seeds and Seed Quality (3 hours)
- 4.1 Definition of seed
- 4.2 Seed quality
- 4.3 Seed viability
- 4.4 Seed germination
- 4.5 Seed dormancy
- 4.6 Production of quality seed
- 4.7 Seed processing
- 4.8 Seed testing and certification

5. Maintenance of Soil Productivity (4 hours)
- 5.1 Importance of soil fertility
- 5.2 Improvement and conservation of soil fertility
- 5.3 Manures and fertilizers:
  - 5.3.1 Nutrient content
  - 5.3.2 Selection
  - 5.3.3 Rates and methods of application in major food crops
- 5.4 Green manures and bio-fertilizers
- 5.5 Management of saline, alkaline and acidic soils

6. Cropping System (6 hours)
- 6.1 Crop rotation
  - 6.1.1 Selection of crops in crop rotation
  - 6.1.2 Advantages/disadvantages in selected crop rotations
- 6.2 Mixed cropping
- 6.3 Intercropping
- 6.4 Relay cropping
- 6.5 Multiple cropping
- 6.6 Cropping intensity
- 6.7 Cropping index
- 6.8 Harvest index
- 6.9 Economic and biological yield
- 6.10 Farming systems

7. Weed Management (3 hours)

7.1 Definition
7.2 Losses caused by weeds
7.3 Classification
7.4 Weed Management
7.4.1 Prevention
7.4.2 Control
7.4.3 Eradication

8. Rainfed Farming (1 hours)

9. Cultivation Practices of Major Crops (6 hours)

9.1 Cereal Crops (Rice, Wheat, Maize)
9.2 Grain Legumes (Lentil, greengram)
9.3 Oil Seeds (Mustard, Sunflower)
9.4 Industrial Crops (Sugarcane, Jute)
9.5 Tuber Crops (Potato)

Part-II Horticulture

1. Introduction: (3 hours)

1.1 Meaning, branches and scope of horticulture
1.2 Importance of horticulture
1.3 Feasibility of horticultural development in Nepal
1.4 Classification of horticultural crops

2. Physiology of Horticultural Crops

2.1 Seed and bud dormancy
2.2 Germination- factors and processes
2.3 Juvenility- characteristics and modifications
2.4 Maturity- flowering, fruit-setting , fruit growth, fruit drop and fruit ripening
2.5 Tuber and bulb formation

3. Production of Vegetables and Spice Crops (6 hours)

3.1 Classification of vegetable and spice crops
3.2 Soil and climatic factors in the production of vegetable and spice crops
3.3 Cultural practices to improve and maintain soil fertility (mulching, liming, composting, green manuring, intercropping, crop rotations, contour cropping, alley cropping, terrace farming, agro-forestry)
3.4 Principle of off-season vegetable production
3.5 Cultivation practices of following vegetable crops:
3.5.1 Cole crops (Cauliflower, cabbage)
3.5.2 Bulb crops (Onion)
3.5.3 Solanaceous vegetables (tomato, chilly)
3.5.4 Cucurbits (Cucumber)
3.6 Cultivation practices of following spice crops:
3.6.1 Zinger
3.6.2 Cardamom

4. Production of Fruits and Plantation Crops (6 hours)

4.1 Importance and scope of fruits and plantation crops
4.2 Orchard establishment- site selection, layout, selection of crops and spices
4.3 Nursery management
4.4 Principles of sexual, asexual and micro-propagation
4.5 Orchard management- green manuring, intercropping, cover cropping, mulching, sod culture, liming, weeding, manuring, fertilization, training and pruning
4.6 Cultivation practices of following fruit crops:
4.6.1 Tropical fruits: mango, banana, litchi
4.6.2 Sub-tropical fruits: citrus, grapes, guava
4.6.3 Temperate fruits: apple, pear
4.6.4 Plantation crops: tea, coffee, cardamom

(3 hours)

Part-III: Insect/Pest and Disease Management:

1. Insect/Pest Management (5 hours)

1.1 Introduction to agricultural insects and pests
1.2 Principles and methods of pest control
1.3 Management of important insects/pests of field,
1.4 Vegetable and plantation crops
1.5 Pesticides and their formulations
1.6 Methods of application of insecticides and pesticides

2. Disease Management (5 hours)

1.7 Concept and losses caused by plant diseases
1.8 Causes of plant diseases

1.9 Important diseases of field, vegetable and plantation crops
1.10 Control measures of plant diseases

Practical:

1. Identification of crops and their seeds.
2. Identification of mineral fertilizers.
3. Calculation of rates of fertilizer and manures and their methods of application.
4. Preparation of calendar of operation for sequential cropping, triple cropping, inter-cropping and relay cropping.
5. Calculation of seed rate of different crops and planting materials.
6. Germination, viability and purity test of seeds.
7. Collection, identification and control measures of weeds
8. Calculation of rates of application of insecticides, pesticides and fungicides
9. Identification of fruits and plantation crops.
10. Identification of plants and seeds of vegetables and spices
11. Practice on crop cultural operation in field, vegetable, fruits and plantation crops.

References:

1. Sharma, K.P., K.R. Dahal and K.R. Neupane. 1991. An Introduction to Agronomy. Tribhuvan University, Institute of Agriculture and Animal Science, Rampur, Nepal.
2. Modern Techniques of Raising Field Crops by Chidda Singh. Oxford and IBH Publishing Co., New Delhi
3. Agronomy: Theory and Digest by Cheema S.S. et al. Kalyani Publishers, New Delhi
4. Crop Management by S.S. Singh, Kalyani Publishers, New Delhi
5. Horticulture: Principle and Practices by Acquaah, Prentice-Hall of India Ltd.

Evaluation Scheme:

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

Chapters	Hours	Marks distribution*
Part-I Agronomy		
1 & 2	**6**	**8**
3 & 4	**6**	**8**
5	4	5
6	6	8
7 & 8	4	5
9	6	8
Part-II Horticulture		
1 & 2	6	8
3	6	8
4	6	8
Part-III: Insect/Pest and Disease Management		
1	5	7
2	5	7
Total	**60**	**80**

*There may be minor variation in marks distribution

HYDRAULICS
CE 555

Lecture : 4 **Year : II**
Tutorial : 2 **Part : II**
Practical : 1

Course Objective:

The knowledge of hydraulics is essential to the design of many hydraulic structures. The knowledge of hydraulic is very important to the students and engineers in the field of hydraulic engineering . Hence, this course has been designed to provide basic knowledge of hydraulics to the students of civil engineering so that it would be helpful them to understand the basic phenomena of this science. This course shall be considered as an introduction: common for all civil engineering faculties of Tribhuvan University in the second year second part of undergraduate.

1. Pipe flow (9 hours)

1.1 Introduction to pipe flow, distinguish between pipe and open channel flow.
Reynolds experiment and flow based on Reynolds's number
1.2 Laminar flow (Steady uniform incompressible flow in a circular pipe, shear stress, and velocity distribution)
1.3 Head loss, Hagen Poisseuille equation.
1.4 Turbulent flow. Shear stress development, Prandtl's mixing length theory, velocity Distribution, Darcy-Weisbach equation, Nikuradse's experiments.
1.5 Resistance for commercial pipes, variation of friction factor with Reynold number, Colebrook-White equation, Moody's diagram
1.6 Minor head losses in pipes (losses in sudden enlargement, sudden contraction, Exit loss, entry loss, losses in bends and losses due to different fittings).
1.7 HGL and TEL lines for several cases

2. Simple pipe flow problems and solution (5 hours)

2.1 Three types of simple pipe flow problems and their solution
2.2 Pipe is series, Dupuit equation. Concept of equivalent pipe length
2.3 Pipe in parallel. Different kind of problems and their solution
2.4 Siphons and its application
2.5 Computer programme coding for simple problems

3. Three reservoirs problem and Pipe networks (6 hours)

3.1 Introduction to three reservoir problems
3.2 Solution procedures for possible different cases.
3.3 Introduction to pipe network problems and application
3.4 Hardy-Cross method of solving of pipe networks problems
3.5 Solution procedure by Hardy-Cross method for single and double loops of pipe networks with examples
3.6 Computer programme coding for simple problems

4. Unsteady flow in pipes (5 hours)

4.1 Basic equations for unsteady flow: celerity, Euler's Equation and continuity equation.
4.2 water hammer and its effects
4.3 Propagation of elastic wave in rigid and elastic pipe
4.4 Pressure variation due to gradual and sudden closure of pipe. Pressure variation at given point due to sudden closure of pipe.
4.5 Brief information about the relief devices against water hammer effects as surge tanks.

5. Basics of Open channel flow (3 hours)

5.1 Introduction to open channel flow and its practical application, differences
between open and pipe flows.
5.2 Classification (natural and artificial channel, prismatic and non-prismatic channel, rigid boundary and mobile boundary channel).
5.3 Geometric properties (depth of flow, area of flow, top width, wetted
perimeter, hydraulic radius, hydraulic depth, bed or longitudinal slope, hydraulic slope, energy slope)
5.4 Classification of open channel flow (Steady unsteady; uniform non-uniform; laminar turbulent; sub-critical, super critical, critical and super critical flow; gradually varied, rapidly varied and spatially varied flow)

6. Uniform flow in open channel (7 hours)

6.1 Condition of uniform flow, expression for the shear stress on the boundary of channel
6.2 Flow resistance equations. Darcy-Weisbach, Chezy and Manning equations and their relationship.
6.3 Determination and factors affecting manning's roughness coefficient
6.4 Velocity profile for laminar and turbulent flow, velocity distribution
6.5 Velocity distribution coefficients and their application
6.6 Conveyance, section factor, normal depth and hydraulic exponent for uniform flow computation
6.7 Problems of uniform flow computation
6.8 Best Hydraulic channel sections and determination of section dimensions (rectangular, triangular, trapezoidal and circular section)
6.9 Computer programme coding for simple problems

7. Energy and Momentum Principles in Open channel flow (11 hours)

7.1 Energy principle, specific energy, specific energy curve, criteria for critical flow
7.2 Critical depth computations for all kind of channel sections (prismatic as well as non prismatic) and criteria for critical state of flow.
7.3 Discharge depth relationship
7.4 Application of energy principle and concepts of critical depth concepts (channel width reduction, rise in channel bed, venture flume and broad crested weir)
7.5 Momentum principle, specific force, specific force curve, criteria for critical state of flow, conjugate depth.
7.6 Computer programme coding for simple problems

8. Non-uniform gradually varied flow (GVF) (6 hours)

8.1 Introduction to GVF. Basic assumptions, Dynamic equation and its physical meaning
8.2 Characteristics bed slopes (mild, critical, steep, horizontal and adverse).
8.3 Characteristics and analysis of flow profiles
8.4 Computation of GVF in prismatic channels by (graphical integration, direct integration and direct step and standard step methods)
8.5 Computer programme coding for simple problems

9. Non-uniform rapidly varied flow (RVF) (4 hours)

9.1 Characteristics of RVF. Hydraulic jump as an energy dissipater
9.2 Hydraulic jump in a horizontal rectangular channel. Relationship between hydraulic jump variables (conjugate depth, height of the jump, efficiency jump, length of the jump)
9.3 Energy loss in jump
9.4 Classification of the jump based on the tail water level and Froude number
9.5 Practical application of jump at spillway toe, falls etc.
9.6 computer programme coding for simple problems

10. Flow in mobile boundary channel (4 hours)

10.1 Introduction to rigid and mobile boundary channel
10.2 Rigid boundary channel and its design principle (minimum permissible velocity approach).
10.3 Definition of alluvial channel. Shear stress distribution on the channel boundary.
10.4 Incipient motion condition
10.5 Design of MBC by three approaches (the permissible velocity, tractive force and regime theory approaches)
10.6 Introduction to Shied diagram and its application for designing MBC
10.7 Formation of river beds based on the shear stress.

References:

1. Ven Te Chow "Open channel hydraulic" McGraw-Hill book company limited, 1973
2. K G Ranga Raju "Flow through open channel" Tata McGraw-Hill Publishing Company Limited, New Delhi, Second Edition,1993.
3. D.S. Kumar "Fluid Mechanics and Fluid power Engineering" S.K. Kataria and Sons, sixth edition, 2005
4. K. L. Kumar "Engineering Fluid Mechanics" Eurasia Publishing house (P) Ltd. Ram Nagar New Delhi, 2000.

5. S Ramamrutham “Hydraulics fluid mechanics and fluid machines”,. Dhanpat Rai Publishing Company (P) Ltd. New Delhi Seventh Edition 2006

Practical:

The following exercises will be performed in this course. These are:

1. Head loss in Pipe
2. Determination of manning's coefficient for different surfaces.
3. Flow through open sluice gate
4. Hump and constricted flow analysis
5. Hydraulic jump analysis

Tutorials:

1. **Pipe flow** **(3 hours)**
   Practical examples, numerical examples and derivation.
   There will be tutorial for each sub-section
2. **Simple pipe flow problem and solution** **(2 hours)**
   Practical examples, numerical examples and derivation.
3. **Three reservoir problems and pipe networks** **(4 hours)**
   Practical examples, and numerical examples.
   Use of computer programme(studied in I/I) for solving exercises
4. **Unsteady flow in pipes** **(3 hours)**
   Practical examples, numerical examples and derivation.
   There will be tutorial for each sub-section
5. **Basics of open channel flow** **(1 hours)**
6. **Uniform Flow** **(3 hours)**
   Practical examples, numerical examples and derivation. There will be tutorial for each sub-section
   Use of computer programme (studied in I/I) to solve some problems
7. **Energy and momentum principles in open channel flow** **(4hours)**
   Practical examples, numerical examples and derivation
   There will be tutorial for each sub-section
   Use of computer programme (studied in I/I) to solve some problems
8. **Non-uniform Gradually varied flow** **(4 hours)**
   Practical examples, numerical examples and derivation
   Drawings for flow profiles
   There will be tutorial for each sub-section
   Use of computer programme (studied in I/I) to solve some problems
9. **Non-uniform Rapidly Varied flow** **(2 hours)**
   Practical examples, numerical examples and derivation
   There will be tutorial for each sub-section
10. **Flow in mobile boundary channel** **(2 hours)**
    Practical examples, numerical examples and derivation

Evaluation Scheme:

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

Chapters	Hours	Marks distribution*
1	9	8
2	5	8
3	6	10
4	5	8
5	3	4
6	7	10
7	11	12
8	6	8
9	4	6
10	4	6
Total	**60**	**80**

*There may be minor variation in marks distribution

STRENGTH OF MATERIALS AND THEORY OF STRUCTURES
CE 560

Lectures : 4 **Year : II**
Tutorial : 1 **Part : II**
Practical : 1

Course Objective:
To provide fundamental knowledge, concept and methods of analysis for solving problems related to different load conditions, stress and strains on structures and components. The students will be able to analyze, calculate and design basic components of structure and other engineering components on the basis of strength, stiffness and stability of the material

1. Introduction (2 hours)
- 1.1 Types of structure based on material used
- 1.2 Statically determinate and indeterminate structures

2. Stresses and Strains (3 hours)
- 2.1 Definition of stresses and strains
- 2.2 Relationship between stresses and strains
- 2.3 Elastic and elastoplastic behavior under various stress loads

3. Types and Characteristics of Stresses (2 hours)
- 3.1 Ultimate stresses
- 3.2 Allowable stresses and factor of safety
- 3.3 Stress concentrations
- 3.4 Elastic constants

4. Stress and Strain Analysis (4 hours)
- 4.1 Hooke's law, modulus of elasticity, Poisson's ratio and modulus of rigidity
- 4.2 Deformation of axially loaded bar, generalized Hooke's law
- 4.3 Stresses due to change in temperature

5. Theory of Flexure and Torsion (6 hours)
- 5.1 Coplanar and pure bending
- 5.2 Radius of curvature, flexural stiffness
- 5.3 Elastic and plastic bending
- 5.4 Beam deflection
- 5.5 Definition of torsion
- 5.6 Calculation of torsion stresses

6. Introduction to Buckling (3 hours)
- 12.1 Definition of buckling
- 12.2 Euler's formula for column with different end restraints
- 12.3 Concept of effective length and slenderness ratio

7. Deflection of Beam (8 hours)
- 7.1 Strain energy and complementary strain
- 7.2 Deflection by strain energy
- 7.3 Curvature, slope and deflection
- 7.4 Deflection by moment area method
- 7.5 Deflection by conjugate beam method

8. Influence Lines for Simple Structures (6 hours)
- 8.1 Introduction to moving static loads
- 8.2 Concept of Influence line
- 8.3 Influence line diagram for reaction at supports, bending moments and shear force
- 8.4 Determination of reactions, bending moments and shear forces using influence line diagram

9. Statically Determinate Arches and Frames (6 hours)
- 9.1 Types of arches and frames
- 9.2 Three hinged arches with the support at the same level
- 9.3 Determination of support reactions, shearing forces, axial forces, bending moments in arches and frames

10. Statically Indeterminate Structures (12 hours)
- 10.1 Types of indeterminate structures, static and kinematic indeterminancy
- 10.2 Slope deflection method
- 10.3 Moment distribution method

11. Elementary Matrix Method (8 hours)
- 11.1 Flexibility and stiffness matrix- use for simple cases

Practical:
1. Uniaxial tension test
2. Torsion test
3. Bending test
4. Column behaviour
5. Deflection of beams

6. Measurement of reactions in three hinged arches under different loading arrangements
7. Influence lines for beams

References:

1. Gere and Timonsenko: Mechanics of Materials
2. C.H.Norris, J.B Wilbur and S. Utku " Elementary Structural Analysis" McGraw-Hill Book Co.
3. E.P.Popov "Mechanics of Materials", 2nd Ed., New Delhi, Prentice hall of India
4. C.K.Wang " Intermediate Structural Analysis", McGraw Hill International 1989

Evaluation Scheme:

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

Chapters	Hours	Marks distribution*
1,2	5	6
3,4	6	8
5,6	9	15
7	8	10
8	6	8
9	6	8
10	12	15
11	8	10
Total	**60**	**80**

*There may be minor variation in marks distribution

NUMERICAL METHODS
SH 553

Lecture : 3 **Year : II**
Tutorial : 1 **Part : II**
Practical : 3

Course objective:
The course aims to introduce numerical methods used for the solution of engineering problems. The course emphasizes algorithm development and programming and application to realistic engineering problems.

1. Introduction, Approximation and errors of computation (4 hours)
- 1.1. Introduction, Importance of Numerical Methods
- 1.2. Approximation and Errors in computation
- 1.3. Taylor's series
- 1.4. Newton's Finite differences (forward , Backward, central difference, divided difference)
- 1.5. Difference operators, shift operators, differential operators
- 1.6. Uses and Importance of Computer programming in Numerical Methods.

2. Solutions of Nonlinear Equations (5 hours)
- 2.1. Bisection Method
- 2.2. Newton Raphson method (two equation solution)
- 2.3. Regula-Falsi Method , Secant method
- 2.4. Fixed point iteration method
- 2.5. Rate of convergence and comparisons of these Methods

3. Solution of system of linear algebraic equations (8 hours)
- 3.1. Gauss elimination method with pivoting strategies
- 3.2. Gauss-Jordan method
- 3.3. LU Factorization
- 3.4. Iterative methods (Jacobi method, Gauss-Seidel method)
- 3.5. Eigen value and Eigen vector using Power method

4. Interpolation (8 hours)
- 4.1. Newton's Interpolation (forward, backward)
- 4.2. Central difference interpolation: Stirling's Formula, Bessel's Formula
- 4.3. Lagrange interpolation
- 4.4. Least square method of fitting linear and nonlinear curve for discrete data and continuous function
- 4.5. Spline Interpolation (Cubic Spline)

5. Numerical Differentiation and Integration (6 hours)
- 5.1. Numerical Differentiation formulae
- 5.2. Maxima and minima
- 5.3. Newton-Cote general quadrature formula
- 5.4. Trapezoidal, Simpson's 1/3, 3/8 rule
- 5.5. Romberg integration
- 5.6. Gaussian integration (Gaussian – Legendre Formula 2 point and 3 point)

6. Solution of ordinary differential equations (6 hours)
- 6.1. Euler's and modified Euler's method
- 6.2. Runge Kutta methods for 1st and 2nd order ordinary differential equations
- 6.3. Solution of boundary value problem by finite difference method and shooting method.

7. Numerical solution of Partial differential Equation (8 hours)
- 7.1. Classification of partial differential equation(Elliptic, parabolic, and Hyperbolic)
- 7.2. Solution of Laplace equation (standard five point formula with iterative method)
- 7.3. Solution of Poisson equation (finite difference approximation)
- 7.4. Solution of Elliptic equation by Relaxation Method
- 7.5. Solution of one dimensional Heat equation by Schmidt method

Practical:
Algorithm and program development in C programming language of following:
1. Generate difference table.
2. At least two from Bisection method, Newton Raphson method, Secant method
3. At least one from Gauss elimination method or Gauss Jordan method. Finding largest Eigen value and corresponding vector by Power method.
4. Lagrange interpolation. Curve fitting by Least square method.
5. Differentiation by Newton's finite difference method. Integration using Simpson's 3/8 rule
6. Solution of 1st order differential equation using RK-4 method
7. Partial differential equation (Laplace equation)
8. Numerical solutions using Matlab.

References:

1. Dr. B.S.Grewal, " Numerical Methods in Engineering and Science ", Khanna Publication, 7th edition.
2. Robert J schilling, Sandra l harries , " Applied Numerical Methods for Engineers using MATLAB and C.", 3rd edition Thomson Brooks/cole.
3. Richard L. Burden, J.Douglas Faires, "Numerical Analysis 7th edition" , Thomson / Brooks/cole
4. John. H. Mathews, Kurtis Fink ," Numerical Methods Using MATLAB 3rd edition " ,Prentice Hall publication
5. JAAN KIUSALAAS , " Numerical Methods in Engineering with MATLAB" , Cambridge Publication

Evaluation scheme:

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

Chapters	Hours	Marks distribution*
1 & 2	9	**16**
3	8	**16**
4	8	**16**
5	6	**10**
6	6	**10**
7	8	**12**
Total	**45**	**80**

* There could be a minor deviation in the marks distribution

FARM MACHINERY AND EQUIPMENT
AE 551

Lectures : 3 **Year: II**
Tutorial : 1 **Part:II**
Practical : 2

Course Objective:
After the completion of this course students will be familiar with primary and secondary tillage and emplements, seeding, planting, harvesting, threshing, plant protection machines, equipment and there management.

1. Objectives and Scope of Farm Mechanization (2 hours)
- 1.1 Objectives of Farm Mechanization
- 1.2 Scope and Limitations of Farm Mechanization in Nepal
- 1.3 Policies and Related Strategies to Farm Mechanization in Nepal

2. Tillage (3 hours)
- 2.1 Definition and Objectives of Tillage
- 2.2 Primary and Secondary Tillage
- 2.3 Physical, Chemical and Biological Influences of Tillage
- 2.4 Changing Views on Tillage

3. Primary and Secondary Tillage Implements
- 3.1 Mould Board Ploughs (3 **hours)**
  - 3.1.1 Types, Construction and Working Principle
  - 3.1.2 Accessories and Attachments
  - 3.1.3 Forces Acting on the Plough Bottom
- 3.2 Disc Ploughs (3 hours)
  - 3.2.1 Types, Construction and Working Principle
  - 3.2.2 Accessories and Attachments
  - 3.2.3 Forces Acting on Plough Bottom
- 3.3 Harrows (4 hours)
  - 3.3.1 Types, Construction and Working Principle of Harrows
  - 3.3.2 Functions of Harrows
  - 3.3.3 Others types of Harrows, their Selection and Use
  - 3.3.4 Forces Acting on Disk Harrow and their Analysis
- 3.4 Rotary Tillage Tools and Implements (4 hours)
  - 3.4.1 Types, Construction and Working Principle of Rotavator, Stirring Plough and Auger Plough
  - 3.4.2 Advantages and Limitations of Rotary Tillage Tools
  - 3.4.3 Forces Acting on Rotary Tillage Tools
- 3.5 Specialized Tillage Implements and Tools (2 hours)
  - 3.5.1 Sub-Soiler and Chisel Ploughs
  - 3.5.2 Rider and Bundformer
  - 3.5.3 Puddler
- 3.6 Tools and Implements for Intercultural Operations (3 hours)
  - 3.6.1 Objectives of Intercultural Operations
  - 3.6.2 Types, Construction and Working Principle of Cultivator
  - 3.6.3 Types of Intercultural Tools- sweep, shovel, hoe, rotary hoe etc.
  - 3.6.4 Horticultural Tools and Gadgets
- 3.7 Measurement of Forces on Tillage Tools (3 hours)
  - 3.7.1 Dynamic Soil Properties Affecting Soil-Tool Interaction
  - 3.7.2 Types of Dynamometers: spring, hydraulic, eddy current, strain-gauge
  - 3.7.3 Draft, Unit-Draft and Draft Power

4. Seeding and Planting Machines (5 hours)
- 4.1 Methods of Seeding and Planting and their Mechanization
- 4.2 Types, Construction and Working Principle of Drills and Planters
- 4.3 Types, Construction and Working Principle Paddy Trans-planters
- 4.4 Seed and Fertilizer Metering Devices in Drills and Planters
- 4.5 Calibration and Field Adjustments in Drills and Planters
- 4.6 Furrow Openers and Covering Devices in Drills and Planters
- 4.7 Sugarcane and Potato Planters
- 4.8 Recent Advances in Seeding and Planting Implements

5. Machines and Equipment for Plant Protection (4 hours)
- 5.1 Objectives of Spraying and Dusting
- 5.2 Types of Sprayers and Dusters
- 5.3 Working Principle and Components of Sprayers
- 5.4 Working Principle and Components of Duster
- 5.5 Safety in Handling Plant Protection Machines
- 5.6 Selection and Calibration of Sprayers and Dusters

6. Harvesting Machines

6.1 Crop Harvesting Methods and their Mechanization (1 hours)

6.2 Mowers

6.2.1 Types, Working Principle and Constructional Details

6.2.2 Functional Parameters of Mower Cutter-bar

6.2.3 Forces Acting on Cutter-bar

6.2.4 Adjustments and Balancing of Cutter-bar

6.3 Reapers and Windrowers (3 hours)

6.3.1 Types, Working Principle and Constructional Details

6.3.2 Reaper-Binder

6.3.3 Adjustments and Performance

6.4 Harvesters for Other Crops (3 hours)

6.4.1 Potato Digger- working principle and constructional details

6.4.2 Groundnut Harvester- working principle and constructional details

6.4.3 Sugarcane Harvester- working principle and constructional details

6.4.4 Fruit Harvesting Machinery

6.4.5 Cotton Pickers and Stripers

7. Threshing Machines (4 hours)

7.1 Threshing Mechanisms and their Mechanization

7.2 Types Threshers, their Working Principles and Constructional Details

7.3 Factors Affecting Thresher Performance

7.4 Adjustments and Trouble-Shooting in Mechanical Threshers

7.5

8. Combined Harvesters (2 hours)

8.1 Classification and Functional Components of Grain Combines

8.2 Material Flow and Adjustments in Grain Combines

8.3 Adjustments and Trouble-Shooting in Combine Harvesters

9. Chaff and Silage Cutters and Forage Harvesters (2 hours)

9.1 Working Principle and Constructional Details

9.2 Types of Cutter Heads

9.3 Power Requirement and Cutting Energy

9.4 Forage Blower

10. Hill Agricultural Machinery (2 hours)

11. Selection and Economics of Farm Machines and Equipment (4 hours)

11.1 Selection Criteria of Farm Machines and Equipment

11.2 Cost of Operation of Farm Machines- fixed and variable costs

11.3 Management of Farm Machines for Optimum Performance

11.4 Feasibility of Custom Hiring of Farm Machines and Equipment

Practical:

1. Study of Different Farm Operations and Familiarization with Farm Machines and Equipment
2. Study on Animal and Tractor Drawn Mould Board Plough
3. Study on Disk Plough
4. Study on Animal and Tractor Drawn Disk Harrows
5. Study on Rotary Tillage Tools
6. Study on Sub-soiler and Chisel Plough
7. Study on Mechanical Weed Control Machines and Equipments
8. Study on Seeding and Planting Machines
9. Calibration of Seed Drills and Planters
10. Study on Paddy Trans-planters
11. Study on Mowers and Reapers
12. Study on Mechanical Threshers
13. Study on Combined Harvesters
14. Study on Plant Protection Machines and Equipments
15. Measurement of Power Requirement of Farm Machines and Equipments

References:

1. Principle of Farm Machinery (Latest edition) by R. A. Kepner, Roy Bainer and E. L. Barger. C & S Publishers and Distributors, New Delhi, India.
2. Farm Machinery and Equipment, 6th edition by H. P. Smith and L. H. Wilkey. Tata McGraw Hill Publishing Co. Ltd., New Delhi, India.
3. Principle of Agricultural Engineering, Vol. I (Latest Edition) by A. M. Michael and T. P. Ojha. Jain Brothers, New Delhi, India.
4. Farm Machinery, 10th edition by Clude Culpin. ELBS London, UK.
5. Elements of Farm Machines, 1st edition by A. C. Srivastava. Oxford and IBH Publishing Co. Ltd., New Delhi, India.
6. Agricultural Machines by N. I. Kelnin, I. F. Popov and A. V. A. Sakur, Amerind Publishing, New Delhi

7. Testing and Evaluation of Agricultural Machines by M. L. Mehta, S. R. Verma, S. K. Mishra and V. K. Sharma.
8. Agricultural Engineering (Through Worked Examples) by Radhey Lal and A. C. Datta. Saroj Publishers, Allahabad.

Evaluation Scheme:

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

Chapters	Hours	Marks distribution*
1 & 2	5	6
3.1 & 3.2	6	8
3.3 & 3.4	8	12
3.5 & 3.6	5	6
3.7	3	5
4	5	7
5	4	6
6 ,7 & 8	16	20
9 & 10	4	5
11	4	5
Total	60	80

*There may be minor deviation in marks distribution.