



# JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

KAKINADA – 533 003, Andhra Pradesh, India

## R23 AGRICULTURAL ENGINEERING COURSE STRUCTURE & SYLLABUS

### B. Tech – II Year I Semester

S.No.	Category	Title	L	T	P	Credits
1	BS & H	Statistical Methods and Numerical Analysis	3	0	0	3
2	BS & H	Universal human values – understanding harmony and Ethical human conduct	2	1	0	3
3	Engineering Science	Fluid Mechanics and Open Channel Hydraulics	2	0	0	2
4	Professional Core	Farm Power and Tractor Systems	3	0	0	3
5	Professional Core	Engineering Mechanics	3	0	0	3
6	Engineering Science	Fluid Mechanics and Open Channel Hydraulics Lab	0	0	2	1
7	Professional Core	Field Operation and Maintenance of Tractors Lab	0	0	3	1.5
8	Professional Core	Engineering Mechanics Lab	0	0	3	1.5
9	Skill Enhancement Course	Machine and Production Drawing	0	1	2	2
10	Audit Course	Environmental Science	2	0	0	-
<b>Total</b>			<b>15</b>	<b>2</b>	<b>10</b>	<b>20</b>

### B. Tech – II Year II Semester

S.No.	Category	Title	L	T	P	Credits
1	Management Course- I	Managerial Economics and Financial Analysis	2	0	0	2
2	Engineering Science	Properties and Strength of Materials	3	0	0	3
3	Professional Core	Ground Water Hydrology, Wells and Pumps	3	0	0	3
4	Professional Core	Surveying and Leveling	3	0	0	3
5	Professional Core	Heat and Mass Transfer	3	0	0	3
6	Professional Core	Ground Water Hydrology, Wells and Pumps Lab	0	0	2	1
7	Professional Core	Surveying and Leveling Lab	0	0	3	1.5
8	Professional Core	Heat and Mass Transfer Lab	0	0	3	1.5
9	Skill enhancement Course	Analysis/Simulation using MATLAB	0	1	2	2
10	BS&H	Design Thinking and Innovation	1	0	2	2
<b>Total</b>			<b>15</b>	<b>1</b>	<b>12</b>	<b>22</b>
<b>Honors (Pool – 1)/Minor Courses</b>			<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>
Mandatory Community Service Project Internship of 8 Weeks Duration During Summer Vacation... To be evaluated in III Year I Semester						



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II Year - I Semester

L	T	P	C
3	0	0	3

### STATISTICAL METHODS AND NUMERICAL ANALYSIS

**OBJECTIVE:** To enable the students for acquiring the knowledge about statistical methods, Numerical analysis, Numerical integration, numerical integration by Trapezoidal, Simpson's and Weddle's rules, Laplace transform, Laplace transforms of elementary functions and Experimental designs.

#### UNIT - I

Statistical methods, testing of hypothesis, concepts, testing of significance based on Z-test, t-test, F-test, Chi-square test, contingency table, correlation, regression, testing of significance of correlation and regression, multiple linear regression, ANOVA, one-way and two-way classifications, factorial experiment concepts ( $2^2$ ,  $2^3$ , mixed factorials).

#### UNIT - II

Numerical analysis: Finite differences, various difference operators and their relationships, factorial notation, interpolation with equal intervals, Newton's forward and backward interpolation formulae.

#### UNIT - III

Numerical integration, numerical integration by Trapezoidal, Simpson's and Weddle's rules; Numerical solution of ordinary differential equations by Picard's method, Taylor's series method, Euler's method, modified Euler's method, Runge-Kutta method; Laplace transforms: Definition of Laplace transform, Laplace transforms of elementary functions,

#### UNIT - IV

Properties of Laplace transforms, inverse Laplace transforms, transforms of derivatives, integrals, transform of function multiplied by  $t^n$ , transform of function divided by  $t$ , convolution theorem, application of Laplace transforms to solve ordinary differential equations and simultaneous differential equations.

#### UNIT - V

Experimental designs: Basic designs, completely randomized design (CRD) - Layout and analysis with equal and unequal number of observations, randomized block design (RBD) - Layout and analysis, Latin square design (LSD) - Layout and analysis; Response surface methodology.



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**TEXTBOOKS**

1. Erwin Kreyszig, 2006. Advanced Engineering Mathematics, 9th Ed. John Wiley & Sons, New York, USA.
2. B.S. Grewal. 2004. Higher Engineering Mathematics. Khanna Publishers, Delhi.

**REFERENCES**

1. P.P. Gupta and C.C. Malik. 1993. Calculus of Finite Differences and Numerical Analysis. Krishna Prakash Mandor, Meerut.



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II Year - I Semester

L	T	P	C
2	1	0	3

### UNIVERSAL HUMAN VALUES – UNDERSTANDING HARMONY AND ETHICAL HUMAN CONDUCT

#### COURSE OBJECTIVES:

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
- Strengthening of self-reflection.
- Development of commitment and courage to act.

#### UNIT – I:

##### Course Introduction - Need, Basic Guidelines, Content and Process for Value Education (8 Hrs)

Purpose and motivation for the course, recapitulation from Universal Human Values-I  
Self-Exploration–what is it? - Its content and process; ‘Natural Acceptance’ and Experiential Validation- as the process for self-exploration

Continuous Happiness and Prosperity- A look at basic Human Aspirations

Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority

Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario  
Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

#### UNIT – II:

##### Understanding Harmony in the Human Being - Harmony in Myself! (12 Hrs)

Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’

Understanding the needs of Self (‘I’) and ‘Body’ - happiness and physical facility

Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer)

Understanding the characteristics and activities of ‘I’ and harmony in ‘I’

Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail

Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one’s own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.



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#### **UNIT – III:**

**(8 Hrs)**

Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship.

Understanding the meaning of Trust; Difference between intention and competence

Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship.

Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals

Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

#### **UNIT – IV:**

Understanding Harmony in the Nature and Existence -Whole existence as Coexistence

**(10 Hrs)**

Understanding the harmony in the Nature

Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self- regulation in nature

Understanding Existence as Co-existence of mutually interacting units in all- pervasive space  
Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film “Home” can be used), pollution, depletion of resources and role of technology etc.

#### **UNIT – V:**

Implications of the above Holistic Understanding of Harmony on Professional Ethics **(8Hrs)**

Natural acceptance of human values Definitiveness of Ethical Human Conduct

Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order

Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco- friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.

Case studies of typical holistic technologies, management models and production systems  
Strategy for transition from the present state to Universal Human Order:

- a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers
- b. At the level of society: as mutually enriching institutions and organizations Sum up.



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Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

#### **Text Books:**

1. R R Gaur, R Asthana, G P Bagaria, “A Foundation Course in Human Values and Professional Ethics”, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
2. R R Gaur, R Asthana, G P Bagaria, “Teachers’ Manual for A Foundation Course in Human Values and Professional Ethics”, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

#### **Reference Books:**

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantik, 1999.
2. N. Tripathi, “Human Values”, New Age Intl. Publishers, New Delhi, 2004. The Story of Stuff (Book).
3. Mohandas Karamchand Gandhi “The Story of My Experiments with Truth”
4. E. F.Schumacher. “Small is Beautiful” Slow is Beautiful –Cecile Andrews
5. J C Kumarappa “Economy of Permanence” Pandit Sunderlal “Bharat Mein Angreji Raj” Dharampal, “Rediscovering India”
6. Mohandas K. Gandhi, “Hind Swaraj or Indian Home Rule” India Wins Freedom - Maulana Abdul Kalam Azad Vivekananda - Romain Rolland(English)
7. Gandhi - Romain Rolland (English)

#### **MODE OF CONDUCT**

Lecture hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them. Tutorial hours are to be used for practice sessions.

While analyzing and discussing the topic, the faculty mentor’s role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.

In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one’s own self and do self-observation, self-reflection and self-exploration.

Scenarios may be used to initiate discussion. The student is encouraged to take up “ordinary” situations rather than” extra-ordinary” situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practicals are how you behave and work in real life.



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Depending on the nature of topics, worksheets, home assignments and/or activities are included. The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.

**Course Outcomes:** At the end of the course students will be able to

CO's	Statements	Bloom's Level
CO1	Become more aware of themselves, and their surroundings (family, society, nature)	L2
CO2	Become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.	L 5
CO3	Have better critical ability.	L 4
CO4	Become sensitive to their commitment towards what they have understood (human values, human relationship and human society).	L 2
CO5	apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.	L3



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L	T	P	C
2	0	0	2

II Year - I Semester

### FLUID MECHANICS AND OPEN CHANNEL HYDRAULICS

**OBJECTIVE:** To enable the students to design efficient water conveyance systems like canals, channels and pipes from places of origin to delivery points by acquiring knowledge on the principles of mechanics of fluids, water measurement and regulation and open channel hydraulic principles.

#### OUTCOMES:

- Acquaintance of skills on basic principles of fluid, their properties, flow patterns, classification of flow regimes etc.,
- Impart knowledge on boundary layer theory and their principals, analysis of fluid flow and theories of flow regimes–energy calculations.
- Development of skills on Buoyancy principals, flow measuring devises, their flow dynamics. Skill development on flow through pipes & their concepts, dynamics of mix flow principles of dimensional analysis and similitude, open channel flow dynamic.
- Skill development on open channel flow dynamics, concepts & principles, their design procedures.

#### UNIT-I

Fluids-Definitions-classification-properties, dimensions. Fluid pressure–Introduction–measurement of fluid pressure, piezo meter tube manometry, types of manometers. Mechanical gauges-Bourdon’s tube pressure gauge, diaphragm pressure gauge, dead weight pressure gauge. Fluid static force on submerged surfaces, total force on horizontal, vertical and inclined surfaces. Center of pressure of an inclined immersed surface, center of pressure of a composite section. Pressure on a curved surface and its applications. Kinematics of fluid flow– Introduction, continuity of fluid flow, Types of flow lines.

#### UNIT-II

Boundary layer theory- Thickness of boundary layer, Thickness of boundary layer in alaminar flow, Thickness of boundary layer in a turbulent flow, Prandtl’s experiment of boundary layer separation. Dynamics of fluid flow – Various forms of energy in fluid flow, frictional loss, general equation. Bernoulli’s theorem, Euler’s equation of motion. Practical applications of Bernoulli’s theorem, verturimeter, pitot tube, orifice meter.

#### UNIT-III

Buoyancy of flotation–metacentric height. Flow through orifices(measurement of discharge) – Types of orifices, jet of water, vena contract a, hydraulic coefficients, experimental method for hydraulic Coefficients, discharge through a rectangular orifice. Flow through orifices (measurement of time) – Time of emptying a square, rectangular



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or circular tank through an orifice at its bottom, time of emptying a hemispherical tank through an orifice at its bottom. Time of emptying a circular horizontal tank through an orifice at its bottom. Time of emptying a tank of variable cross-section through an orifice. Flow through mouthpieces – Types of Mouthpieces; Loss of head of a liquid flowing in a pipe, discharge through a mouthpiece. Flow over notches- Types of notches, discharge over a rectangular notch, triangular notch, stepped notch. Time of emptying a tank over a rectangular notch, triangular notch. Flow over weirs – Types of weirs, discharge over a weir, Francis's formula for discharge over a rectangular weir (effect of end contractions), Bazin's formula for discharge over a rectangular weir, velocity of approach, determination of velocity of approach.

#### **UNIT-IV**

Flow through simple pipes – Loss of head in pipes, Darcy's formula for loss of head in pipes, Chezy's formula for loss of head in pipes. Transmission of power through pipes, Time of emptying a tank through a long pipe, Time of flow from one tank into another through a long pipe. Flow through compound pipes – Discharge through a compound pipe (pipes in series), discharge through pipes in parallel, equivalent size of a pipe, discharge through branched pipes from one reservoir to another. Dimensional analysis and similitude – Rayleigh's method and Buckingham's  $\pi$  theorem. Types of similarities, dimensional analysis, dimensionless numbers, introduction to fluid machinery. Open channel hydraulics- classification of open channel and definitions. Chezy's formula for discharge through an open channel.

#### **UNIT-V**

Bazin's formula for discharge through open channel, numerical problems on design through open channel, Kutter's formula for discharge, problems on design. Manning's formula for discharge through an open channel. Channels of most economical cross-sections – Conditions for maximum discharge through a channel of rectangular section, trapezoidal section, circular section. Specific energy concept - Specific energy of a flowing fluid, specific energy diagram, critical depth, type of flows, critical velocity. Velocity and pressure profiles in open channels. Hydraulic jump, types of hydraulic jumps, depth of hydraulic jump, loss of head due to hydraulic jump.

#### **TEXTBOOKS**

1. Hydraulics and Fluid Mechanics, Modi PM and Seth S.M. 1973. Standard Book House, Delhi.
2. Open Channel Hydraulics, Chow VT, 1983, McGraw Hill Book Co., New Delhi.

#### **REFERENCES**

1. A Text book of Hydraulics, Fluid Mechanics and Hydraulic Machines, Khurmi, R.S. 1970., S.Chand & Company Ltd., New Delhi.



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## R23 AGRICULTURAL ENGINEERING COURSE STRUCTURE & SYLLABUS

II Year - I Semester

L	T	P	C
3	0	0	3

### FARM POWER AND TRACTOR SYSTEMS

**OBJECTIVE:** To enable the students for acquiring the knowledge pertaining to systems like transmission system clutch, types of clutches, types of Gear, sliding, constant mesh type tractor power out lets like P.T.O, belt pulley, drawbar, traction theory rolling, resistance, rim pull, crawler tractor.

#### OUTCOMES:

- Skill development on farm power sources classification I.C engine components and construction, operating systems.
- Skill development on fuel supply ignition, cooling & lubrication electrical ignition, fuels & their properties, governing systems of IC engines, power transmission, clutches & its applications.
- Acquaintance of knowledge on clutch types, concepts & principles, single and multiple plate clutches, working mechanism, gear theory and principles, differential unit of its functions, final drive & its applications.
- Skill development on principles of fluid coupling & torque connector, brakes principles, classification & friction concepts of hydraulic system in factors.
- Skill development on tractor powers outlets, P.T.O and its applications, Tractor testing and its main components, CG estimation, Tractor chassis its mechanics.

#### UNIT-I

Source of farm power—Conventional and non-conventional energy sources, classification of tractor and I.C engines, study of I.C engine components and their construction, operating principles and functions, Engine systems and their construction details and adjustment.

#### UNIT-II

Valves and valve mechanism, fuel and air supply stems, cooling and lubricating systems, electrical and ignition systems, I.C engine fuels and their properties, detonation and knocking in I C engines, Study of properties of coolants, antifreeze and anti-corrosion materials, Lubricant types & study of their properties – Engine governing systems. Introduction to transmission system – Power transmission system of tractor –Functions of a power transmission system. Clutch – Necessity of clutch in a tractor, essential features of good clutch, principal working of clutch, clutch repairs and maintenance.

#### UNIT-III

Types of clutch – Friction clutch, dog clutch and fluid coupling, friction clutch – Single plate clutch or single disc clutch, multiple plate clutch or multiple disc clutch, cone clutch. Single plate clutch or single disc clutch – Constructional details and principle of working mechanism. Multiple plate clutch, splined sleeve clutch type – Constructional details and principle of working mechanism ratchet and pawl arrangement mechanism –Constructional details and principle of working mechanism. Gears– Necessity for providing gear box, Selective sliding type, constant mesh type, Mechanical



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advantage in gears, torque ratio in gears, working of gear box. Differential unit and final drive–Differential, functions of crown wheel, differential lock, functions, final drive–functions of final drive.

#### **UNIT-IV**

Fluid coupling and torque connector, brake mechanism, requirements of good braking systems, classification of brakes, Mechanical brake and hydraulic brake– Working mechanism. Steering mechanism–Qualities of steering mechanism, main parts of steering mechanism types of steering boxes, working of hydraulic steering. Hydraulic control system – Working principals, basic components of hydraulic system – Types of hydraulic system, position control, draft control, mixed control, precautions for hydraulic system.

#### **UNIT-V**

Tractor power outlets – P.T.O., construction details; Belt pulley constructional details, tractor power outlet, drawbar, construction details. Traction-Traction efficiency, method for improving traction, coefficient of traction, rolling resistance, wheel slip or track slip, Rimpul - crawler tractor. Tractor testing – Preparation for tests, types of tests, test at the main power take off, test at varying speeds at full load, test at varying load, belt or pulley shaft test, drawbar test, tractor engine performance. Determination of centre of gravity, Suspension method, balancing method, weighing method. Tractor chassis machines, functions of chassis frame. Tractor chassis – Mechanics of tractor chassis.

#### **TEXTBOOKS**

1. Farm Tractor Maintenance and Repair. Jain. S.C. and Roy C.R.1984. TMH Publishing Co.Ltd., New Delhi.
2. Tractors and their power units. Lijedhal J.B.Carleton W.M.Turnquist P.K. and Smith D.W.1984.AVI PublishingCo. Inc., Westport, Connecticut.

#### **REFERENCES**

1. Farm Gas Engines and Tractors. Fred J.R.1963.AlliedPublisherPvt. Ltd., Bombay.
2. Farm Machines and their Equipment. Nakra C.P., 1986. Dhanpet RaiandSons.1982 Nai Sarak, New Delhi.



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L	T	P	C
3	0	0	3

II Year - I Semester

### ENGINEERING MECHANICS

**Objectives:** The students completing this course are expected to understand the concepts of forces and its resolution in different planes, resultant of force system, Forces acting on a body, their free body diagrams using graphical methods. They are required to understand the concepts of centre of gravity and moments of inertia and their application, Analysis of frames and trusses, different types of motion, friction and application of work - energy method.

#### Course outcomes:

1. The student should be able to draw free body diagrams for FBDs for particles and rigid bodies in plane and space and problems to solve the unknown forces, orientations and geometric parameters.
2. The student should be able to determine centroid for lines, areas and center of gravity for volumes and their composites.
3. The student should be able to determine area and mass moment of inertia for composite sections
4. The student should be able to analyze motion of particles and rigid bodies and apply the principles of motion, work energy and impulse – momentum.

#### UNIT – I

**Objectives: The students are to be exposed to the concepts of force and friction, direction and its application.**

Introduction to Engg. Mechanics – Basic Concepts.

**Systems of Forces:** Coplanar Concurrent Forces – Components in Space – Resultant – Moment of Force and its Application – Couples and Resultant of Force Systems.

**Friction:** Introduction, limiting friction and impending motion, coulomb's laws of dry friction, coefficient of friction, cone of friction

#### UNIT II

**Objectives: The students are to be exposed to application of free body diagrams. Solution to problems using graphical methods and law of triangle of forces.**

**Equilibrium of Systems of Forces:** Free Body Diagrams, Lami's Theorem, Equations of Equilibrium of Coplanar Systems, Graphical method for the equilibrium, Triangle law of forces, converse of the law of polygon of forces condition of equilibrium, Equations of Equilibrium for Spatial System of forces, Numerical examples on spatial system of forces using vector approach, Analysis of plane trusses.



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#### **UNIT – III**

**Objectives:** The students are to be exposed to concepts of centre of gravity. The students are to be exposed to concepts of moment of inertia and polar moment of inertia including transfer methods and their applications.

**Centroid:** Centroids of simple figures (from basic principles) – Centroids of Composite Figures

**Centre of Gravity:** Centre of gravity of simple body (from basic principles), centre of gravity of composite bodies, Pappus theorems.

**Area moments of Inertia:** Definition – Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures, Products of Inertia, Transfer Formula for Product of Inertia. **Mass Moment of Inertia:** Moment of Inertia of Masses, Transfer Formula for Mass Moments of Inertia, mass moment of inertia of composite bodies.

#### **UNIT – IV**

**Objectives:** The students are to be exposed to motion in straight line and in curvilinear paths, its velocity and acceleration computation and methods of representing plane motion.

**Rectilinear and Curvilinear motion of a particle:** Kinematics and Kinetics- Work Energy method and applications to particle motion- Impulse momentum method.

#### **UNIT – V**

**Objectives:** The students are to be exposed to rigid motion kinematics and kinetics

**Rigid body Motion:** Kinematics and kinetics of translation, Rotation about fixed axis and plane motion, Work Energy method and Impulse momentum method.

#### **TEXTBOOK:**

1. Engg. Mechanics - S.Timoshenko &D.H.Young., 4<sup>th</sup>Edn - , Mc Graw Hill Publications.



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II Year - I Semester

L	T	P	C
0	0	2	1

### FLUID MECHANICS AND OPEN CHANNEL HYDRAULICS LAB

#### OUTCOMES

1. Imparting practical skills on determination of metacentric height and Bernoulli's theorem.
2. Exposure to practical skills on measurement of discharge with venture meter and pilot tubes.
3. Acquiring practical skills on determining discharge coefficient to rectangular, triangular and trapezoidal weir and orifices.
4. Imposing practical skills on flow measurement..... Broad crested weirs and open channels.
5. Imposing practical skills on determination of head losses in pipes, roughness coefficient of open channels.
6. Practical exposes on determination of velocity and pressure in open channels, construction of flow-net problems on flow-nets.

#### PRACTICAL

1. Determination of metacentric height
2. Verification of Bernoulli's theorem
3. Measurement of discharge with a venture meter
4. Measurement of velocity with a pilot tube
5. Determination of coefficient of discharge of rectangular weir
6. Determination of coefficient of discharge of triangular weir
7. Determination of coefficient of discharge of trapezoidal weir
8. Determination of hydraulic coefficient of orifices
9. Experiment on broad crested weir
10. Determination of head losses in pipes
11. Experiments on open channels
12. Determination of roughness coefficients of open channels
13. Measurement of velocity and pressure profiles in open channels
14. Construction of flow net
15. Problems on construction off low net



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II Year - I Semester

L	T	P	C
0	0	3	1.5

### FIELD OPERATIONS AND MAINTENANCE OF TRACTORS LAB

**OBJECTIVES:** To enable the students for acquiring the knowledge pertaining to maintenance of tractors like periodical maintenance (50 to 100 hours, 200 to 250 hours, 480 to 500 engine working hours, 960 to 1000 hours) and trouble shooting and remedial measures of all systems - fuel system, lubrication system, cooling system and ignition system.

### OUTCOMES

1. Improved practical skills on air kind fuel filtration systems, lubrication system and their maintenance in tractors.
2. Practical skills improvement on maintenance of transmission and radiators cooling systems in tractor.
3. Practical skills development on maintenance of tractor ignition and hydraulic systems.
4. Practical knowledge on periodical maintenance of tractors, emission of smoke, clutch and brake system maintenance.
5. Practical skill development on maintenance of train machinery and implements.
6. Practical knowledge on tractor on-off practice of tractors.

### Practical

1. Tractor Systems - maintenance of air fuel system – cleaning of air cleaners – frequent troubles and Remedies – process to remove air lock in the diesel engine – precautions in handling diesel fuels in diesel engine.
2. Maintenance of lubrication system – frequent troubles and remedies – troubles in lubrication system excessive oil consumption – care and maintenance of lubrication system.
3. Maintenance of transmission system – general maintenance – differential trouble shooting – Frequent troubles and Remedies.
4. Maintenance of cooling system and cleaning of radiators – frequent troubles and remedies  
Cooling system troubles – overheating – slow warm up of the engine – care and maintenance of cooling system.
5. Maintenance of ignition system – care and maintenance of batteries – Frequent troubles and remedies – causes of ignition failure in battery system.
6. Maintenance of hydraulic system – working principle – basic components of hydraulic system – types of hydraulic system – frequent troubles and remedies – repairs and maintenance of hydraulic system – precautions of hydraulic system.



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### **R23 AGRICULTURAL ENGINEERING COURSE STRUCTURE & SYLLABUS**

- Periodical maintenance of tractors – at 8-10 engine working hours – at 50-60 engine working hours and at 100-120 engine working hours
- Periodical maintenance of tractors – at 200-250 engine working hours, at 480-500 engine working hours and at 960-1000 engine working hours. Emission of smoke – over heating of engines – maintenance of clutch brakes hydraulic problems.
- 7. Maintenance of agricultural machinery before and after use like primary tillage implements,
- 8. M.B. plough, disc plough and secondary tillage implements - harrows, seed drills, weeders, cultivators.
- 9. Starting and stopping practice of the tractor and familiarization with instrumentation panel and controls
- 10. Driving in forward and reverse gears, driving safety signs and study of a tractor.

#### **TEXTBOOKS**

1. Farm Tractor Maintenance and Repair. Jain S.C. and Roy C.R. 1984. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
2. Farm Machines and their Equipment. Nakra C.P. 1986 Dhanpet Rai and Sons. New Delhi.

#### **REFERENCES**

1. Elements of Agricultural Engineering. J. S. Sahay 1992. Agro Book Agency, Patna.
2. Tractors and their Power units. L. E. J. B. Carleton W. M. Turnquist P. K. and Smith D. W. 1984. AVI Publishing Co., Inc., Westport, Connecticut.



# **JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**

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## **R23 AGRICULTURAL ENGINEERING COURSE STRUCTURE & SYLLABUS**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>

### **II Year - I Semester**

#### **ENGINEERING MECHANICS LAB**

1. To verify the polygon law forces with the help of force polygon apparatus
2. To determine law of machine for single purchase crab
3. To determine law of machine for double purchase crab
4. To determine law of machine for differential axle and wheel
5. Determination of reactions at the supports of a simply supported beam with the help of parallel forces apparatus
6. Determination of coefficient of friction using inclined plane set-up
7. Determination of coefficient of friction using coil friction set-up
8. To find forces in jib and tie with the help of jib crane apparatus
9. Determination of forces in members of jib crane (co-planer concurrent force system)
10. To determine the efficiency of a simple screw jack apparatus
11. To determine the efficiency of a simple wheel and axle apparatus
12. To determine efficiency of a worm and worm wheel apparatus
13. To calculate the forces in the members of member truss apparatus
14. To determine the principle of moments with the help of bell crank lever apparatus
15. To determine efficiency of a differential wheel and axle apparatus
16. Determination of moment of inertia of a fly wheel



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## R23 AGRICULTURAL ENGINEERING COURSE STRUCTURE & SYLLABUS

L	T	P	C
0	1	2	2

### II Year - I Semester

## MACHINE AND PRODUCTION DRAWING

### Course Objectives

1. To understand and apply national and international standards while drawing machine components.
2. To understand the concept of various tolerances and fits used for component design
3. To familiarize in drawing assembly, orthographic and sectional views of various machine components.

### Course Outcomes

- CO1 Identify the national and international standards pertaining to machine drawing.
- CO2 Apply limits and tolerances to assemblies and choose appropriate fits.
- CO3 Recognize machining and surface finish symbols.
- CO4 Explain the functional and manufacturing datum.
- CO5 Illustrate various machine components through drawings.

### Tutorial

#### Machine Drawing Conventions

Need for drawing conventions – introduction to IS conventions- Standardization- Interchangeability Selective assembly- Tolerance

- a) Conventional representation of materials, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs, ribs.
- b) Types of sections – selection of section planes and drawing of sections and auxiliary sectional views. Parts not usually sectioned.
- c) Methods of dimensioning, general rules for sizes and placement of dimensions for holes, centers, curved tapered features and surface finish indication
- d) Title boxes, their size, location and details – common abbreviations & their liberal usage
- e) Types of Drawings – working drawings for machine parts.

#### Drawing of Machine Elements and simple parts

Selection of Views, additional views for the following machine elements and parts with every drawing proportions.

- a) Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, set screws.
- b) Keys, cotter joints, knuckle joint, Hook's joint
- c) Riveted joints for plates
- d) Shaft couplings.
- e) Journal, pivot and collar and foot step bearings.



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## **R23 AGRICULTURAL ENGINEERING COURSE STRUCTURE & SYLLABUS**

### **Assembly Drawings**

Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions.

- a) Engine parts –Gear pump, Fuel pump, petrol Engine connecting rod, piston, stuffing box and eccentric assembly.
- b) Other machine parts – Screws jack, Machine swivel vice, Plummer block, Tailstock and Tool post.

### **Manufacturing Drawing**

- a) Introduction of Limits and fits, fundamental deviations for Hole based and Shaft based systems, alpha numeric designation of limits & fits. Types of Fits. Form and positional tolerances.
- b) Conventional practices of indicating limits and fits, geometrical form and position tolerances, surface finish and surface treatments requirements. Study of Examples involving selection of fits and calculation of limits. Suggestion of suitable fits for mating parts.
- c) Representation of limits fits and tolerances for mating parts. Use any four parts of above assembly drawings and prepare manufacturing drawing with dimensional and geometric tolerances.

### **Practical**

1. Classification of Machine Drawings
2. Principles of Drawings
3. Sectioning
4. IS/ISO codes
5. Dimensioning
6. Limits, tolerances and fits
7. Surface finish
8. Important symbols and conventional representation in machine drawing
9. Assembly and part drawings of simple assemblies and sub-assemblies of machine parts viz., couplings and its types, clutches, bearings, gear assemblies, I.C. Engine components, valves, machine tools, screw fasteners, key joints, coupling, riveted joints, welded joints, etc.
10. Structural applications, assembly drawings, production drawings, reproduction of Drawing
11. Introduction to computer aided drafting
12. Introduction of Solid 3D modeling



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**TEXTBOOKS**

1. R.K. Dhawan. Machine Drawing. S.Chand Publications
2. K.L.Narayana, P.Kannaiah & K. Venkata Reddy. A textbook on Production Drawing. PHI Publishers

**REFERENCES**

1. N. D. Bhatt, Machine Drawing, Charotar Publishing House Pvt Ltd, 2016.
2. N. Sidheswar, P. Kanniah and V.V.S. Sastry, Machine Drawing, Tata McGraw Hill, 2001
3. SP 46: 1988 Engineering Drawing Practice for School & Colleges. Bureau of Indian Standards
4. K. R. Gopalakrishna, Machine Drawing, 9th Ed., Subhas Stores, Bangalore, 2005.
5. K.L.Narayana, P.Kannaiah & K. Venkata Reddy. Machine Drawing. New Age Publishers
6. P.S.Gill “Machine Drawing” S.K. Kataria & Sons
7. K. Venkata Reddy. Production Drawing.
8. N. Siddeswar. Machine Drawing.



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## R23 AGRICULTURAL ENGINEERING COURSE STRUCTURE & SYLLABUS

II Year - I Semester

L	T	P	C
2	0	0	0

### ENVIRONMENTAL SCIENCE

#### COURSE OBJECTIVES:

The objectives of the course are to impart:

- Over all understanding of the natural resources.
- Basic understanding of the eco system and its diversity.
- Acquaintance on various environmental challenges induced due to unplanned anthropogenic activities.
- An understanding of the environmental impact of developmental activities.
- Awareness on the social issues, environmental legislation and global treaties.

#### UNIT-I

**Multidisciplinary nature of Environmental Studies:** Definition, Scope and Importance – Sustainability: Stockholm and Rio Summit–Global Environmental Challenges: Global warming and climate change, acid rains, ozone layer depletion, population growth and explosion, effects; Role of information technology in environment and human health.

**Ecosystems:** Concept of an ecosystem. - Structure and function of an ecosystem; Producers, consumer and decomposers. - Energy flow in the ecosystem - Ecological succession. - Food chains, food webs and ecological pyramids; Introduction, types, characteristic features, structure and function of Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems.

#### UNIT-II

**Natural Resources:** Natural resources and associated problems.

Forest resources: Use and over – exploitation, deforestation – Timber extraction – Mining, dams and other effects on forest and tribal people. Water resources: Use and over utilization of surface and ground water–Floods, drought, conflicts over water, dams –benefits and problems. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources. Food resources: World food problems, changes caused by non-agriculture activities-effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity. Energy resources: Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources. Land resources: Land as a resource, land degradation, Wasteland reclamation, man induced landslides, soil erosion and desertification; Role of an individual in conservation of natural resources; Equitable use of resources for sustainable life styles.

#### UNIT-III

**Biodiversity and its conservation:** Definition: genetic, species and ecosystem diversity-classification -Value of biodiversity: consumptive use, productive use, social-Biodiversity at national and local levels. India as a mega-diversity nation - Hot-spots of biodiversity - Threats to biodiversity: habitat loss, man-wildlife conflicts. - Endangered and endemic species of India – Conservation of biodiversity: conservation of biodiversity.



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### R23 AGRICULTURAL ENGINEERING COURSE STRUCTURE & SYLLABUS

#### UNIT – IV

**Environmental Pollution:** Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution, Nuclear hazards. Role of an individual in prevention of pollution. - Pollution case studies, Sustainable Life Studies. Impact of Fire Crackers on Men and his well being.

**Solid Waste Management:** Sources, Classification, effects and control measures of urban and industrial solid wastes. Consumerism and waste products, Biomedical, Hazardous and e-waste management.

#### UNIT-V

**Social Issues and the Environment:** Urban problems related to energy-Water conservation, rain water harvesting–Resettlement and rehabilitation of people;its problems and concerns. Environmental ethics: Issues and possible solutions. Environmental Protection Act-Air (Prevention and Control of Pollution)Act.–Water (Prevention and control of Pollution)Act-Wild life Protection Act-Forest Conservation Act-Issues involved in enforcement of environmental legislation. -Public awareness.

**Environmental Management:** Impact Assessment and its significance various stages of EIA, preparation of EMP and EIS, Environmental audit. Ecotourism, Green Campus –Green business and Green politics.

The student should Visit an Industry/Ecosystem and submit a report individually on any issues related to Environmental Studies course and make a power point presentation.

#### TEXTBOOKS

1. Environmental Studies, K.V.S.G. Murali Krishna, VGS Publishers, Vijayawada
2. Environmental Studies, R. Rajagopalan, 2<sup>nd</sup> Edition, 2011, Oxford University Press.

#### REFERENCES

1. Environmental Studies, P.N. Palanisamy, P. Manikandan, A. Geetha, and K. Manjula Rani; Pearson Education, Chennai
2. Text Book of Environmental Studies, Deeshita Dave & P. Udaya Bhaskar, Cengage Learning.
3. A Text book of Environmental Studies, Shaashi Chawla, TMH, New Delhi
4. Environmental Studies, Benny Joseph, Tata McGraw Hill Co, New Delhi
5. Perspectives in Environment Studies, Anubha Kaushik, C P Kaushik, New Age International Publishers, 2014



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## R23 AGRICULTURAL ENGINEERING COURSE STRUCTURE & SYLLABUS

II Year - II Semester

L	T	P	C
2	0	0	2

### MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS

#### Course Objectives:

- To inculcate the basic knowledge of microeconomics and financial accounting
- To make the students learn how demand is estimated for different products, input-output relationship for optimizing production and cost
- To Know the Various types of market structure and pricing methods and strategy
- To give an overview on investment appraisal methods to promote the students to learn how to plan long-term investment decisions.
- To provide fundamental skills on accounting and to explain the process of preparing financial statements.

#### Course Outcomes:

- Define the concepts related to Managerial Economics, financial accounting and management(L2)
- Understand the fundamentals of Economics viz., Demand, Production, cost, revenue and markets (L2)
- Apply the Concept of Production cost and revenues for effective Business decision (L3)
- Analyze how to invest their capital and maximize returns (L4)
- Evaluate the capital budgeting techniques. (L5)
- Develop the accounting statements and evaluate the financial performance of business entity (L5)

#### UNIT - I Managerial Economics

Introduction – Nature, meaning, significance, functions, and advantages. Demand-Concept, Function, Law of Demand - Demand Elasticity- Types – Measurement. Demand Forecasting-Factors governing Forecasting, Methods. Managerial Economics and Financial Accounting and Management.

#### UNIT - II Production and Cost Analysis

Introduction – Nature, meaning, significance, functions and advantages. Production Function– Least- cost combination– Short run and long run Production Function- Isoquants and Is costs, Cost & Break-Even Analysis - Cost concepts and Cost behaviour- Break-Even Analysis (BEA) - Determination of Break-Even Point (Simple Problems).

#### UNIT - III Business Organizations and Markets

Introduction – Forms of Business Organizations- Sole Proprietary - Partnership - Joint Stock Companies - Public Sector Enterprises. Types of Markets - Perfect and Imperfect



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Competition - Features of Perfect Competition Monopoly- Monopolistic Competition– Oligopoly-Price-Output Determination - Pricing Methods and Strategies

#### **UNIT - IV Capital Budgeting**

Introduction – Nature, meaning, significance. Types of Working Capital, Components, Sources of Short-term and Long-term Capital, Estimating Working capital requirements. Capital Budgeting– Features, Proposals, Methods and Evaluation. Projects – Pay Back Method, Accounting Rate of Return (ARR) Net Present Value (NPV) Internal Rate Return (IRR) Method (sample problems)

#### **UNIT - V Financial Accounting and Analysis**

Introduction – Concepts and Conventions- Double-Entry Bookkeeping, Journal, Ledger, Trial Balance- Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments). Introduction to Financial Analysis - Analysis and Interpretation of Liquidity Ratios, Activity Ratios, and Capital structure Ratios and Profitability.

#### **Textbooks:**

1. Varshney & Maheswari: Managerial Economics, Sultan Chand.
2. Aryasri: Business Economics and Financial Analysis, 4/e, MGH.

#### **Reference Books:**

1. Ahuja HI Managerial economics Schand.
2. S.A. Siddiqui and A.S. Siddiqui: Managerial Economics and Financial Analysis, New Age International.
3. Joseph G. Nellis and David Parker: Principles of Business Economics, Pearson, 2/e, New Delhi.
4. Domnick Salvatore: Managerial Economics in a Global Economy, Cengage.

#### **Online Learning Resources:**

<https://www.slideshare.net/123ps/managerial-economics-ppt>  
<https://www.slideshare.net/rossanz/production-and-cost-45827016>  
<https://www.slideshare.net/darkyla/business-organizations-19917607>  
<https://www.slideshare.net/balarajbl/market-and-classification-of-market>  
<https://www.slideshare.net/ruchi101/capital-budgeting-ppt-59565396>  
<https://www.slideshare.net/ashu1983/financial-accounting>



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## R23 AGRICULTURAL ENGINEERING COURSE STRUCTURE & SYLLABUS

II Year - II Semester

L	T	P	C
3	0	0	3

### PROPERTIES AND STRENGTH OF MATERIALS

**OBJECTIVE:** To enable the students to know about different materials used for engineering constructions like buildings, roads, farm structures and metals and other materials for manufacturing farm equipment, implements, dairy and food processing equipment.

#### OUTCOMES:

- Skill development on basic properties of engineering materials and their uses, testing of materials.
- Knowledge development on properties and application of difference of concrete, varieties, distempers, glass, rubber and plywood, plastics, iron-based materials, alloy etc., Development of skill on stress – strain analysis of beams under different types of loading patterns.
- Acquaintance of skill on Euler's theory and buckling load, analysis on columns & different types of columns.
- Skill development on different types of joints (Riveting), welding analysis cantilever, fixed, continuous beams, theory of moments and their analysis.

#### UNIT-I

Properties of engineering materials, classifications of rocks, sources of stones and natural bed of stones, properties, varieties and uses of stones, properties, composition and uses of bricks, classification and tests of bricks, properties, varieties and uses of tiles, properties, varieties and uses of Lime, Properties, varieties and uses of Cement, Properties, varieties and uses of cement mortar, properties.

#### UNIT-II

Varieties and uses of concrete, properties, varieties and uses of sand, properties, varieties and uses of paints, properties, varieties and uses of varnishes, properties, varieties and uses of distempers. Characteristics and uses of glass, rubber, plywood, plastics. Characteristic sand uses of wrought iron, cast iron, steel, aluminium, copper, nickel; Alloys of Aluminium and its properties, Alloys of Copper and its properties, Alloys of Nickel and its properties; Definition and types of timber, seasoning of timber, industrial timber and uses of timber, Methods of heat treatment of steel.

#### UNIT-III

Introduction – Stresses, tensile, compressive and shear-strains, units-elastic curve - Elastic limit Poisson's ratio, stresses in uniformity tapered circular sections, stresses in bars of composite, sections, thermal stresses and strains in simple bars and composite bars; Elastic constants- Young's modulus, bulk modulus and shear modulus - relation between them; Stresses on oblique planes, Mohr's circle method; Direct stresses in one plane, direct



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stresses in two planes- accompanied by shear stress. Deflection of beams, relation between slope, deflection and radius of curvature. Methods of finding out slopes and deflections of beams, double integration method. Slope and deflection equations of a simply supported beam with a central point load, simply supported beam with eccentric point load. Simply supported beam with a uniformly distributed load, Columns and struts.

#### **UNIT-IV**

Euler's column theory. Assumptions of Euler's column theory; Buckling load-derivations, types of end conditions of columns, both ends hinged, both ends fixed, one end fixed and other hinged; Expression for buckling load of a column with one end fixed other free, with one end fixed and other hinged, expression for buckling load of a column with both end shinged, with both ends. Fixed types of end conditions of columns, both ends hinged, both ends fixed, one end fixed and other is hinged and one end fixed and other end is free. Types of end conditions of columns, both ends hinged, both ends fixed, one end fixed and other is hinged and one end fixed and other end is free. Limitations of Euler's formula Rankine's formula for columns.

#### **Unit-V**

Riveted joints, types of joint strength of a rivet and riveted joint, efficiency of a riveted joint. Design of riveted joints, eccentric riveted connections, Welded joist, types of welded joints, strength of welded joints, technical terms. Design of welded joints, eccentric welded joints. Dams, forces acting, stressed at the base of dam. Stability of dams, design of base width of dams. Propped cantilever and beams – Deflection and slope equations; Fixed and continuous beams – Deflection and slope equations, Super position theorem – Claypeyron's theorem of three moments, application of Clayperon's theorem of three moments, Moment distribution methods. Analysis of statistically –in determinate beams.

#### **TEXTBOOKS**

1. Engineering Materials, Rangwala, S.C.1994. Charotar Publishing House, Anand.
2. Strength of Materials by Ramamrutham S.2003. Dhanapathrai & Sons, NaiSarak, NewDelhi.

#### **REFERENCES**

1. Material of constructions Deshpande RS1977. United Book Corporation, Poona.
2. Manufacturing Process. Hazra Choudhury 1985. Media Promoters and Publishers Private Limited, Bombay.
3. Workshop Technology (Part-I) Chapman W.A.J. 1994.Aronold Publishers, New Delhi.
4. Engineering Materials. Rangwala S.C. 1994.Charotar Publishing House, Anand.
5. Mechanics of Structures (Vol.I) Junnarkar S.B.2001-Charotar Publishing House, Anand.



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## R23 AGRICULTURAL ENGINEERING COURSE STRUCTURE & SYLLABUS

II Year - II Semester

L	T	P	C
3	0	0	3

### GROUND WATER HYDROLOGY, WELL AND PUMPS

**OBJECTIVE:** To enable the students to acquire knowledge on aquifers and estimation of their different properties like hydraulic conductivity, transmissibility, storage coefficient, specific yield, leakage factor, hydraulic resistance under steady and unsteady state conditions in wells dug under different aquifers, well drilling and development methods and equipment design of gravel pack in bore well. Further to make the students to acquire knowledge on various pumps available commercially, their selection, operation and maintenance with due importance to find out the cost of operation.

#### OUTCOMES:

- Skill development on principles of ground water resources development, different acquaintance and their principles.
- Imparting knowledge on theory of open well hydraulics and drilling methods.
- Skill development on aquifers characteristics under steady and unsteady state conditions, multiples well systems for coastal areas.
- Knowledge development to students on artificial ground water recharge classification of indigenous pumps, solar pumps, wind mill pumps etc.,
- Skill development on principles of Centrifugal pumps, principles & characteristics, High lift pumps, mixed flow pumps and vertical turbine pump sets.

#### UNIT-I

Water resources status of India-Occurrence and Movement of ground water and aquifers– Types of water bearing formations – Unconfined, confined, semi confined aquifers Perched water table condition–Diagrammatic representation.

#### UNIT-II

Classification of wells – Design of open wells – Ground water replenishment – Ground water exploration – Methods of drilling of wells – Common well drilling difficulties Gravel packing – well screens – Development of well.

#### UNIT – III

Aquifer characteristics - Influencing yield of wells - Determination of aquifer parameters – Steady state and unsteady state conditions – Well interference and multiple well point systems in coastal areas.



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#### **UNIT – IV**

Surface and subsurface exploitation and estimation of ground water potential –Artificial ground water recharge – Ground water project formulation–Classification of indigenous pumps – Wind powered water lifts – Solar powered and bio gas operated water lifts Reciprocating pumps.

#### **UNIT – V**

Centrifugal pumps – Terminology on horse power – Selection of pump installation and troubleshooting of pumps – Performance characteristic curves – Effect of change of impeller dimensions on performance characteristics. Hydraulic ram– Propeller pumps - Mixedflowpumps-Airliftpumps–Priming–Verticalturbinepumps–Submersiblepumps. Cost economics.

#### **TEXTBOOKS**

1. Ground Water and Tube Wells-Garg SP1985. Oxford and IBH publish in company limited, New Delhi.
2. Water Well land Pump Engineering–Michael AM and Khepar ST1989 Tata McGraw-Hill Publishing company limited, New Delhi.

#### **REFERENCES**

1. Irrigation Theory and Practice–Michael AM2008 Vikas Publishing House Pvt.Ltd, New Delhi.



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## R23 AGRICULTURAL ENGINEERING COURSE STRUCTURE & SYLLABUS

II Year - II Semester

L	T	P	C
3	0	0	3

### SURVEYING AND LEVELING

#### COURSEOBJECTIVES:

Surveying and leveling curriculum which is re-oriented to the needs of non-circuitual branches of graduate engineering courses offered by JNT University: Kakinada that serves as a transit to understand the branch specific advanced topics. The course is designed to:

#### UNIT-I

**INTRODUCTION:** Overview of plane surveying (chain, compass and plane table), Objectives, Principles and classifications. Distance measurement conventions and methods; use of chain and tape, Electronic distance measurements, Meridians, Azimuths and Bearings, declination, computation of angle.

#### UNIT-II

**LEVELINGANDCONTOURING:** Concept and Terminology, Temporary and permanent adjustments - method of leveling. Characteristics and Uses of contours-methods of conducting contour surveys and their plotting.

#### UNIT-III

**COMPUTATION OF AREAS AND VOLUMES:** Area from field notes, computation of areas along irregular boundaries and area consisting of regular boundaries. Embankments and cutting for a level section and two level sections with and without transverse slopes, determination of the capacity of reservoir, volume of barrow pits.

#### UNIT-IV

**THEODOLITE:** The odolite, description, uses and adjustments-temporary and permanent, measurement of horizontal and vertical angles. Principles of Electronic Theodolite.Trigonometrical leveling, Traversing.

#### UNIT-V

#### TACHEOMETRICSURVEYING:

Stadia and tangential methods of Tacheometry. Distance and Elevation formulae for Staff vertical position. Types of curves, design and setting out-simple and compound curves.

**INDTRODUCTION TO ADVANCED SURVEYING:** Introduction to geodetic surveying, Total Station and Global positioning system, Introduction to Geographic information system(GIS).



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**TEXTBOOKS**

1. Surveying (Vol – 1, 2 & 3), by B.C.Punmia, Ashok Kumar Jain and Arun Kumar Jain – Laxmi Publications (P)ltd., New Delhi
2. Duggal SK, Surveying (Vol-1&2), Tata Mc-GrawHill Publishing Co. Ltd.NewDelhi,2004.

**REFERENCES**

1. Text book of Surveying by C.Venkataramaiah, University Press.



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## R23 AGRICULTURAL ENGINEERING COURSE STRUCTURE & SYLLABUS

L	T	P	C
3	0	0	3

II Year - II Semester

### HEAT AND MASS TRANSFER

**OBJECTIVE:** To enable the students to know about the transport phenomenon in materials through heat and mass transfer for applications in unit operations of dairy and food engineering.

#### OUTCOMES:

- Skill development on principles of heat and mass transfer, steady state heat transfer & its analysis, measurement of thermal conducting of pleasure & composite walls, tubes and spheres, multi layer tubes.
- Skill development on conduction principles of different materials in parallel, combined convection and conduction, concept of insulation.
- Skill development on conduction, convection and radiation analysis of heat and mass transfer, different Lawson radiation theory.
- Imparting skills on unsteady state analysis of heat transfer in fins, free & force convection, cooling theories and principles.
- Skill development on theory and principles of heat exchanges, their analysis, frick's law of mass transfer coefficients, Reynolds analogy.

#### UNIT-I

Introductory concepts, application of heat and mass transfer, modes of heat transfer examples, Fourier's law of heat transport. Introduction to steady state heat transfer - Onedimensionalsteadystateheatconductionequation.Thermalconductivityofdifferent materials – Measurement - insulation Materials, one dimensional steady state conduction through plane and composite walls, conduction through tubes and spheres with and without heat generation, conduction through multi layer tubes.

#### UNIT-II

Electrical analogy - Conduction through materials in parallel, combined convection and conduction and overall heat transfer coefficients, problem solving, Concept of critical thickness of insulation for a cylinder, problem solving,

#### UNIT -III

Radiation heat transfer - Introduction, absorptivity, reflectivity and transmissivity. Blackbody and monochromatic radiation, Plank's law, Stefan-Boltzman law, Krichhoff's law, grey bodies and emissive power, solid angle intensity of radiation. Radiation exchange between black surfaces, geometric configuration factor. Heat transfer analysis involving conduction, convection and radiation by networks.



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### **R23 AGRICULTURAL ENGINEERING COURSE STRUCTURE & SYLLABUS**

#### **UNIT - IV**

Unsteady state heat transfer - Unsteady state system with negligible internal thermal resistance –equation for different geometries, Fins- Heat transfer from extended surfaces, types of fins, numerical, free and force & convection. Newton's law of cooling, heat transfer coefficient in convection. Dimensional analysis of free and forced convection. Useful non - dimensional numbers and empirical relationships for free and forced convection.

#### **Unit- V**

Equation of laminar boundary layer on flat plate and a tube, laminar forced convection on a flat plate and in a tube, combined free and forced convection, types of heat exchangers, fouling factor, log mean temperature difference, heat exchanger performance, transfer units, heat exchanger analysis restricted to parallel and counter flow heat exchangers. Steady state molecular diffusion in fluids at rest and in laminar flow-Fick's law mass transfer coefficients, Reynold's analogy.

#### **TEXTBOOKS**

1. Transport processes and Unit Operations, Geankoplis C.J.1992. Allyn and Bacon Inc., Newton, Massachusetts.
2. Heat Transfer, Holman JP 1989. Mc Graw Hill Book Co., New Delhi.

#### **REFERENCES**

1. Fundamentals of Heat and Mass Transfer, Incropera FP and DeWitt DP1980 John Wiley and Sons. New York.
2. Engineering Heat Transfer, Gupta CP and Prakash R 1994. Nem Chand and Bros., Roorkee.
3. Heat transfer, Rajput S. Chand & Co, New Delhi.



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## **R23 AGRICULTURAL ENGINEERING COURSE STRUCTURE & SYLLABUS**

**II Year - II Semester**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

### **GROUND WATER HYDROLOGY, WELL AND PUMPS LAB**

1. Verification of Darcy's Law
2. Study of different drilling equipment
3. Sieve analysis for gravel and well screens design
4. Estimation of specific yield and specific retention
5. Testing of well screen
6. Estimation of aquifer parameters by Theis method, Coopers-Jacob method, Chow method; Theis Recovery method
7. Well design under confined and unconfined conditions
8. Well losses and well efficiency
9. Estimating ground water balance
10. Study of artificial ground water recharge structures
11. Study of radial flow and mixed flow centrifugal pumps, multistage centrifugal pumps, turbine, propeller and other pumps
12. Installation of centrifugal pump
13. Testing of centrifugal pump and study of cavitation
14. Study of hydraulic ram
15. Study and testing of submersible pump.
16. Estimation of different irrigation water quality parameter

### **TEXTBOOKS**

1. Michael AM, Khepar SD. and SK Sondhi. 2008. Water Well and Pumps, 2nd Edition, Tata Mc-Graw Hill.
2. Todd David Keith and Larry W. Mays. 2004. Groundwater Hydrology, 3rd Edition, John Wiley & Sons, New York (International Book Distributing Company Lucknow).

### **REFERENCES**

1. Michael AM. and Ojha TP. 2014. Principles of Agricultural Engineering Vol-II, 5th Edition. Jain Brothers Publication, New Delhi.



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**II Year - II Semester**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>

**SURVEYING AND LEVELING LAB**

**(Any 10 of the following listed 15 experiments)**

**LIST OF EXPERIMENTS**

1. Survey of an area by chain survey (closed traverse) & Plotting.
2. Determination of distance between two in accessible points with compass.
3. Surveying of a given area by prismatic compass (closed traverse) and plotting after adjustment.
4. Radiation method, intersection methods by plane Table survey.
5. Two point and three-point problems in plane table survey.
6. Fly levelling (differential leveling).
7. An exercise of L.S and C.S and plotting.
8. One exercise on contouring.
9. Study of the odolite in detail- practice for measurement of horizontal and vertical angles.
10. Measurement of horizontal angles by method of repetition and reiteration.
11. Trigonometric Leveling - Heights and distance problem (Two Exercises).
12. Heights and distance using Principles of tachometric surveying(Two Exercises).
13. Area determination, traversing contouring using total station.
14. Determination of remote height and state out using total station.
15. Distance, gradient, Difference in height between two in accessible points using total station.



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<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>

### **II Year - II Semester**

#### **HEAT AND MASS TRANSFER LAB**

1. COP of VCR System with Capillary and thermal expansion valve.
2. Determination of overall heat transfer coefficient of a composite lab
3. Determination of heat transfer rate through a lagged pipe.
4. Determination of heat transfer rate through a concentric sphere
5. Determination of thermal conductivity of a metal rod.
6. Determination of efficiency of a pin-fin
7. Determination of heat transfer coefficient in natural and forced convection
8. Determination of effectiveness of parallel and counter flow heat exchangers.
9. Determination of emissivity of a given surface.
10. Determination of Stefan Boltzman constant.
11. Determination of heat transfer rate in drop and film wise condensation.
12. Determination of critical heat flux.
13. Determination of Thermal conductivity of liquids and gases.
14. Investigation of Lambert's cosine law.



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<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>1</b>	<b>2</b>	<b>2</b>

### **II Year - II Semester**

#### **ANALYSIS / SIMULATION USING MATLAB**

1. Development of soil monitoring systems
2. Analysis of harvesting equipment design parameters and performance
3. Assessment of disease management
4. Development and optimisation of smarter irrigation system
5. Analysis of safety storage of harvested crops
6. Analysis of effective usage of water resources
7. Tractor position tracking using MATLAB
8. Air and water quality monitoring system for healthy crop environment.
9. Development of real-time monitoring system of agricultural fields
10. Using wireless sensor network in an agricultural field also to develop a smart farming environment.
11. Monitoring the critical factor as water quality to enhance the growth of crops is develop using sensors
12. Stock management system at agricultural storages.



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II Year - II Semester

L	T	P	C
1	0	2	2

### DESIGN THINKING AND INNOVATION

**Course Objectives:** The objectives of the course are to

- Bring awareness on innovative design and new product development.
- Explain the basics of design thinking.
- Familiarize the role of reverse engineering in product development.
- Train how to identify the needs of society and convert into demand.
- Introduce product planning and product development process.

#### UNIT – I Introduction to Design Thinking

Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry.

#### UNIT - II Design Thinking Process

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, customer, journey map, brainstorming, product development

**Activity:** Every student presents their idea in three minutes, Every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.

#### UNIT - III Innovation

Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations. Creativity to Innovation. Teams for innovation, Measuring the impact and value of creativity.

**Activity:** Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation.

#### UNIT - IV Product Design

Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications. Innovation towards product design Case studies.

**Activity:** Importance of modeling, how to set specifications, Explaining their own product design.



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### UNIT – V Design Thinking in Business Processes

Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs. Design thinking for Startups. Defining and testing Business Models and Business Cases. Developing & testing prototypes.

**Activity:** How to market our own product, about maintenance, Reliability and plan for startup.

#### Textbooks:

1. Tim Brown, Change by design, 1/e, Harper Bollins, 2009.
2. Idris Mootee, Design Thinking for Strategic Innovation, 1/e, Adams Media, 2014.

#### Reference Books:

1. David Lee, Design Thinking in the Classroom, Ulysses press, 2018.
2. Shrrutin N Shetty, Design the Future, 1/e, Norton Press, 2018.
3. William lidwell, Kritinaholden, & Jill butter, Universal principles of design, 2/e, Rockport Publishers, 2010.
4. Chesbrough.H, The era of open innovation, 2003.

#### Online Learning Resources:

- <https://nptel.ac.in/courses/110/106/110106124/>
- <https://nptel.ac.in/courses/109/104/109104109/>
- [https://swayam.gov.in/nd1\\_noc19\\_mg60/preview](https://swayam.gov.in/nd1_noc19_mg60/preview)
- [https://onlinecourses.nptel.ac.in/noc22\\_de16/preview](https://onlinecourses.nptel.ac.in/noc22_de16/preview)

#### Course Outcomes:

COs	Statements	Blooms Level
CO1	Define the concepts related to design thinking.	L1
CO2	Explain the fundamentals of Design Thinking and innovation.	L2
CO3	Apply the design thinking techniques for solving problems in various sectors.	L3
CO4	Analyse to work in a multidisciplinary environment.	L4
CO5	Evaluate the value of creativity.	L5



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**COURSE STRUCTURE**

**III Year – I Semester**

S. No.	Category	Subject	L	T	P	C
1	PC	Farm Machinery and Equipment - I	3	0	0	3
2	PC	Agricultural Process Engineering	3	0	0	3
3	PE-I	1. Engineering Properties of Agricultural Produce 2. Greenhouse Technology 3. Tractor Design and Testing	2	0	0	2
4	OE-I	Civil Engineering Department (e.g. Theory of Structures) <b>OR</b> Entrepreneurship Development & Venture Creation	3	0	0	3
5	OE-II	Mechanical Engineering Department (e.g. Kinematics of Machines)	3	0	0	3
6	PC	Farm Machinery and Equipment - I Lab	0	0	3	1.5
7	PC	Agricultural Process Engineering Lab	0	0	3	1.5
8	SEC	Structural Design with ANSYS	0	1	2	2
9	BS&H	Tinkering Lab	0	0	2	1
10		Evaluation of Community Service Internship	-	-	-	2
<b>Total</b>			<b>14</b>	<b>1</b>	<b>10</b>	<b>22</b>
MC	Minor Course (Student may select from the same specialized minors pool)		3	0	3	4.5
MC	Minor Course through SWAYAM / NPTEL (Minimum 12 Week, 3 credit course)		3	0	0	3
HC	Honors Course (Student may select from the same Honors pool)		3	0	0	3
HC	Honors Course (Student may select from the same Honors Pool)		3	0	0	3



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**III Year – II Semester**

S. No.	Category	Subject	L	T	P	Credits
1	PC	Surface Water Hydrology	3	0	0	3
2	PC	Farm Machinery and Equipment - II	3	0	0	3
3	PC	Post-Harvest Engineering of Cereals, Pulses and Oilseeds	3	0	0	3
4	PE-II	1. Food Packaging Technology 2. Watershed Management 3. Human Engineering and Safety	3	0	0	3
5	PE-III	1. Irrigation and Drainage Engineering 2. Production Technology of Agricultural Machinery 3. Dairy and Food Engineering	2	0	0	2
6	OE-III	1. Principles of Database Management Systems <b>or</b> 2. Process Equipment Design (12 weeks NPTEL MOOCS) <b>or</b> 3. The Joy of computing using Python (12 weeks NPTEL MOOCS)	3	0	0	3
7	PC	Farm Machinery and Equipment - II Lab	0	0	2	1
8	PC	Post-Harvest Engineering of Cereals, Pulses and Oilseeds Lab	0	0	2	1
9	SEC	Computational Fluid Dynamics with FLUENT	0	1	2	2
10	AC	Technical Paper Writing and IPR	2	0	0	-
		<b>Total</b>	<b>19</b>	<b>1</b>	<b>6</b>	<b>21</b>
Mandatory Industry Internship of 8 Weeks Duration During Summer Vacation... To be evaluated in IV Year I Semester						
MC	Student may select from the same minors pool		3	0	3	4.5
MC	Minor Course (Student may select from the same specialized minors pool)		3	0	0	3
HC	Student may select from the same honors pool		3	0	0	3
HC	Honors Course ( Student may select from the honors pool)		3	0	0	3



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**HONORS PROGRAMMME**

S. No.	Course Name*	L-T-P	Credits
<b>POOL-1</b>			
1	Management of Canal Irrigation System	3-1-0	4
2	Mechanics of Tillage and Traction	3-1-0	4
3	Post-Harvest Engineering of Horticultural Crops	3-1-0	4
<b>POOL-2</b>			
1	Information Technology for Land and Water Management	3-1-0	4
2	Theory of Machines	3-1-0	4
3	Food Plant Utilities and Sanitation	3-1-0	4
<b>POOL-3</b>			
1	Landscape Irrigation Design and Management	3-1-0	4
2	Tractor Systems and Controls	3-1-0	4
3	Food Quality and Control	3-1-0	4
<b>POOL-4</b>			
1	Floods and Control Measures	3-1-0	4
2	Bio-energy Systems: Design and Applications	3-1-0	4
3	Refrigeration Engineering and Cold Chain	3-1-0	4

\*If S.No. 1 in Pool-1 is selected first time, student has to take S.No. 1 only among Pool-2, Pool-3 and Pool-3 subsequently.

**MOOCs programme will be notified by HoD at the beginning of the semester with 8/12 weeks in duration to earn 2 credits.**

**Professional electives which are not studied, in any form during the programme, can also be selected for Honors Program**



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**MINOR PROGRAM**  
**GENERAL TRACK**  
for II Year II Semester

Course No.	S. No.	Subject	L	T	P	Credits
1	1	Precision Farming Techniques for Protected Cultivation	3	1	0	4
	2	Wasteland Development	3	1	0	4

**MINOR PROGRAM**  
**SPECIALIZED TRACKS**

Course No.	S. No.	Subject	L	T	P	Credits
<b>TRACK 1 Farm Machinery and Power Engineering</b>						
2	1	Farm Machinery Design and Production	3	1	0	4
	2	Testing and Evaluation of Tractors and Farm Equipment	3	1	0	4
	3	Earth Moving Machines	3	1	0	4
<b>TRACK 2 Soil and Water Engineering</b>						
3	1	Sprinkler and Micro Irrigation Systems	3	1	0	4
	2	Minor Irrigation and Command Area Development	3	1	0	4
	3	Agricultural Structures and Environmental Control	3	1	0	4
<b>TRACK 3 Processing and Food Engineering</b>						
4	1	Seed Processing and Storage Engineering	3	1	0	4
	2	Development of Processed Food Products	3	1	0	4
	3	Food Waste and By-products Utilization	3	1	0	4
<b>MOOCs programme will be notified by HoD at the beginning of the semester with 8/12 weeks in duration to earn 2 credits.</b>						



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**OPEN ELECTIVE COURSES FOR OTHER DEPARTMENT STUDENTS**

<b>Open Elective</b>	<b>S. No.</b>	<b>Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
1	1	Principles of Soil Science and Agronomy	3	0	0	3
2	2	Farm Power and Tractor Systems	3	0	0	3
	3	Soil and Water Conservation Engineering	3	0	0	3
3	4	Ground Water Hydrology, Wells and Pumps	3	0	0	3
	5	Surface Water Hydrology	3	0	0	3
4	6	Post-Harvest Engineering of Cereals, Pulses and Oilseeds	3	0	0	3
	7	Agricultural Process Engineering	3	0	0	3



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<b>III Year I Semester</b>	<b>THEORY OF STRUCTURES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Objective:**

To enable the students to acquire knowledge on different soil laws estimation models, run off estimation by rational, curve number, cook's etc. Land use, capability classification, soil conservation measures like contour bunding, terracing, bench terraces, contour trenches and their types and complete design calculations. Also, to enrich the students and familiarize the students in the design of various gully control structures, temporary and permanent, their designs with a due importance to hydrologic, hydraulic and structural phases of design.

**UNIT-I**

Runoff – Factors affecting runoff – Peak Runoff and design peak runoff – its estimation - Rational method – Time of concentration & its estimation – Curve number method – Cook's method. Land use capability classification based on different criteria with a special reference to slope.

**UNIT-II:**

Introduction – Soil and water conservation research in India–Its sub-centers–Soil erosion–Geologic, Types & erosion procedures Accelerated types. Causes and agents of erosion – Factors affecting erosion – Water Erosion–Forms of water erosion – Mechanics of Erosion - Different stages of erosion – Rill – Sheet – Gully and Ravines—Gully erosion of classification, stages of gully development. Soil Loss estimation–Universal Soil Loss equation and modified soil loss equation, Explanation of various terms – Estimation of their various parameters. Erosion control measures – Agronomic and mechanical or engineering measures.

**UNIT-III:**

Wind Erosion – Factors affecting wind erosion, mechanics of wind erosion, Wind erosion control measures – Vegetative, mechanical measures, wind blades and shelter belts, sand dunes stabilization – Wind erosion and its control.

**UNIT-IV:**

Contour bunds – Design of contour bunds – Horizontal interval – Vertical interval – Cross section of the contour bunds – Seepage line consideration. Determination height of bund – Loss of area due to bunding. Design of waste weir – Construction of contour bunds in fields. Graded bunds – Design of graded bunds. Introduction to Conservation Ditching. Contour trenching – Staggered and continuous trenches – Adaptability and types. Terraces – Classification of terraces - Design of narrow based and broad-based terraces. Bench Terraces – Types of bench terraces – Derivation of an equation for finding of vertical interval – Design of bench terraces.

**UNIT-V:** Vegetated water ways – Types of water ways based on shapes – Expression for wetted perimeter – C/S areas – Hydraulic radii – types of vegetation – roughness of different grasses –Design of vegetated water ways. Sedimentation – Sedimentation in reservoirs in streams, estimation and measurement, sediment delivery ratio, trap efficiency – Estimation of



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useful life of reservoir based on sedimentation. Characteristics of contours and preparation of contour maps for water area estimation, Volume calculation – Stage –Volume relationship structures for water harvest, Analysis of top sheets. Introduction to water harvesting techniques – Earthen dams etc. Design of WH Structures, - Farm Pond, Percolation tanks, Check dams, Earthen dams etc. –Introduction to Stream water quality and pollution. Temporary gully control structures – Design – Types like Brush wood dams – Wire Mesh – Dams etc. – Introduction to permanent gully control structures – Design phases – Components of permanent structures. Machining used in earthwork – Estimate preparation for all structures. Goud Schemes or NRM activities and their objectives.

**TEXT BOOKS:**

1. Soil and Water Conservation Engineering. Swab G.O. Frevert R.K. Edminster T.W. and Barnes K.K. 1981 John Wiley and Sons New York.
2. Manual of Soil and Water Conservation Practical. Gurmel Singh. Venkataramanam C. Sastry  
G and Joshi BP. 1994.Oxford and IBH Publishing Co. Ltd., New Delhi.

**REFERENCE BOOKS:**

1. Land and Water Management Engineering. Murthy VVN 2004. Kalyani Publishers, New Delhi.
2. Introduction to Soil and Water Conservation Engineering. Mal B.S. 1995 Kalyani Publishers, Rajinder Nagar, Ludhiana.
3. Reddy, K.S. Manual on “Farm Ponds: A climate resilient technology in Rainfed Agriculture:
4. Design Planning and construction. ICAR, CRIDA Publications; [www.crida.in](http://www.crida.in).

**Course outcomes:**

Upon successful completion of this course, learner will be able to:

CO1: Calculate Peak run off, time of conservation

CO2: Estimate soil loss by using Universal Soil Loss equation and modified soil loss equation,

CO3: Discuss factors affecting wind erosion, mechanics of wind

CO4: Design contour bunds, graded bunds and bench terraces

CO5: Design vegetated water ways, WH Structures



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<b>III Year I Semester</b>	<b>PRINCIPLES OF SOIL SCIENCE AND AGRONOMY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Objective:**

To impart Knowledge on Soil genesis, properties etc, so as to enable students to design implements in related to soil, soil conservation, irrigation and drainage applications. Also, to enable students to understand farming principles, to grow agricultural field and orchard crop and farming practices.

**Unit I:**

Soil: Definition –soil as a three phase four component system-branches of Soil science difference between surface and sub surface soil, Rocks: Definition – classification of rocks based on mode of formation-igneous sedimentary and metamorphic rocks, Minerals: Definition, classification, primary, secondary, essential, accessory, silicate, non-silicate minerals, light and heavy minerals primary silicate minerals; quartz, feldspars-micas pyroxenes amphiboles secondary silicate; secondary minerals, Ca, Mg, S and Micronutrient containing minerals-chemical formulate, Weathering:- Definition-types of weathering physical weathering of rocks, agents of physical weathering, temperature, water, wind and glaciers, Chemical weathering, solution, hydration, hydrolysis carbonation-oxidation-reduction biological weathering role of plants and animals in weathering. Soil formation: Soil forming factors –active and passive soil factors and their role in soil formation, Soil forming processes: Elluviation, illuviation, humification, calcification, laterization, podzolozation, salinization, alkalization and gleization, Soil Profile, Detailed description of theoretical soil profile, Soil physical properties: Soil separates and their properties. Specific surface, soil texture-definition-textural classes-methods of determination of soil texture, importance of soil structure,

**Unit II:**

Soil structure; Definition-classification based on type, class and grade, factors influencing formation of aggregates-importance and management of soil structure, Soil structure; Definition classification based on type, class and grade-factors influencing formation of aggregates importance and management of soil structure, Soil consistency; Definition-forms of consistency and importance of soil consistency, Bulk density and particle density; factors influencing and their importance; porosity –types-calculation-importance, Soil water; structure of water and the effect of H-bonding on properties of water retention of water in soils-soil moisture tension-soil moisture potential –soil moisture constants. Soil water movement; saturated, unsaturated and vapor flows, laws governing water flow-Darcy's and Poiseuille's law- Infiltration; Factors-importance. Evaporation; Factors influencing evaporation- Ways to minimize it-soil mulch-organic mulch, etc., Soil air; Composition of soil air processes of gaseous exchange –soil aeration indices –and their importance (oxygen content- ODRaeration porosity-redox potential) management of soil air, Soil temperature; influence of soil temperature on plant growth-factors influencing soil temperature-management of soil temperature. Soil color determination importance, Soil colloids: Definition-general



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properties- inorganic and organic colloids origin of charge on colloids (positive & negative).

**Unit-III:**

Secondary silicate clay minerals (inorganic soil colloids) Kaolinite montmorillonite illite their structures and properties, Ion exchange, Cation and anion exchange –factors influencing ion exchange capacity of soils importance of ion exchange calculation of base saturation and exchangeable acidity, Soil organic matter: importance of organic matter CN ration of organic matter and its importance, Soil biology;- Soil flora and fauna their characteristics role of beneficial organisms mineralization-immobilization, nitrogen fixation, nitrification, denitrification, solubilization of phosphorus and sulphur, Soil fertility:- Concepts of soil fertility and soil productivity:- definitions and differences Arnon's criteria of essentiality-essential and beneficial elements-factors influencing availability of nutrients. Problem Soils: Definition – Physical problems soil depth slope soil crust soil compaction drainage submergence (formation adverse effects- effect on soil properties and plant growth management), Chemical problems– classification acid, saline, saline-sodic and calcareous soils-characteristics-nutrient availability in problem soils and their reclamation.

**Unit-IV:**

Irrigation water: Quality of irrigation water-classification based on EC, SAR, RSC and Boron content-use of saline waters in agriculture, Soil taxonomy: New comprehensive system of soil classification (7th approximation) soil orders and their characteristics, Important soil groups of India: Alluvial soils-black soils –red soils laterite soils and coastal soils.

Meaning and scope of agronomy, History of agricultural development in ancient India, Agriculture in civilization era, National and International Agricultural Research Institutes in India, Classification of crops, Classification of field crops, According to Origin, Botanical Commercial, Economical, seasonal, Ontogeny, Agronomic, Leaf Morphology and Special Purpose crops, Definition of climate and weather, Definition of meteorology, Climatology, Agri- meteorology, Introduction, scope and practical utility of Agricultural meteorology, composition and structure of atmosphere, Influence of weather on crop grain development, essential Resources for crop production, factors influencing plant growth, Biotic and Abiotic factors, Crop seasons, Kharif, Rabi and summer seasons in A.P.-Agro-climatic zones of A.P. and India.

**Unit-V:**

Tillage and tillth, Objective of tillage, characteristic of good seed bed, effect of tillage on soil properties (Pore space, texture, structure, bulk density, color of the soil), Types of Tillage, preparatory cultivation, inter cultivation, after cultivation and preparatory cultivation for lowland rice puddling, implement used for seed bed preparation, sowing, inter-cultivation and special operation, Sowing, Methods of sowing, time and depth of sowing of major agricultural crops, Methods and time of application of manure and fertilizers. Weeds-Influence of weeds on crop production, principles and practices of weed management, Basics on soil plant-water relationship, Types of Soil Erosion, Factors influencing soil erosion, Soil conservation, erosion preventive measures, Agronomic measures for soil and water conservation, Dry land Agriculture, Problems of Crop production in dry farming, Agronomic measure in reducing evapo-transpiration losses, Watershed management, aims and Objectives, Organic farming- Sustainable Agriculture, Definition, Principles and importance.



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**TEXT BOOKS:**

1. Principles of Agronomy, Yella Manda Reddy T & Shankar Reddy, Publications.
2. Nature and Properties of soils. Brady Nyle C and Ray R Well 2002. Pearson Education Inc., New Delhi.
3. Fundamental of Soil Science. Indian Society of Soil Science 1988. IARI, New Delhi.

**REFERENCES:**

1. Meteorology, William L Donn, 1965, McGraw-Hill Book. Co. New York.
2. Crop Production in Dry Regions, Arnon L 1972, Leonard Hill Publishing Co., London.
3. Manures and Fertilizers, Yawalkar K S and Agrawal J P, 1977, Agricultural Horticultural Publishing House, Nagpur.
4. Principle of Weed Science, Rao V S, 1992, Oxford and IBH Publishing Co. Ltd., New Delhi.
5. Soil Fertility and Fertilizers, Tisdale S L, Nelson W L, Beaton J D and Havlin J L 1995. Prentice-Hall of India, New Delhi.
6. Introduction to Soil Physics, Hillel D 1982. Academic Press, London.



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<b>III Year I Semester</b>	<b>FARM POWER AND TRACTOR SYSTEMS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVE:** To enable the students for acquiring the knowledge pertaining to systems like transmission system clutch, types of clutches, types of Gear, sliding, constant mesh type tractor power out lets like P.T.O, belt pulley, drawbar, traction theory rolling, resistance, rim pull, crawler tractor.

**OUTCOMES:**

- Skill development on farm power sources classification I.C engine components and construction, operating systems.
- Skill development on fuel supply ignition, cooling & lubrication electrical ignition, fuels & their properties, governing systems of IC engines, power transmission, clutches & its applications.
- Acquaintance of knowledge on clutch types, concepts & principles, single and multiple plate clutches, working mechanism, gear theory and principles, differential unit of its functions, final drive & its applications.
- Skill development on principles of fluid coupling & torque connector, brakes principles, classification & friction concepts of hydraulic system in factors.
- Skill development on tractor powers outlets, P.T.O and its applications, Tractor testing and its main components, CG estimation, Tractor chassis its mechanics.

**UNIT-I**

Source of farm power—Conventional and non-conventional energy sources, classification of tractor and I.C engines, study of I.C engine components and their construction, operating principles and functions, Engine systems and their construction details and adjustment.

**UNIT-II**

Valves and valve mechanism, fuel and air supply stems, cooling and lubricating systems, electrical and ignition systems, I.C engine fuels and their properties, detonation and knocking in I C engines, Study of properties of coolants, antifreeze and anti-corrosion materials, Lubricant types & study of their properties – Engine governing systems. Introduction to transmission system – Power transmission system of tractor –Functions of a power transmission system. Clutch – Necessity of clutch in a tractor, essential features of good clutch, principal working of clutch, clutch repairs and maintenance.

**UNIT-III**

Types of clutch – Friction clutch, dog clutch and fluid coupling, friction clutch – Single plate clutch or single disc clutch, multiple plate clutch or multiple disc clutch, cone clutch. Single plate clutch or single disc clutch – Constructional details and principle of working mechanism. Multiple plate clutch, splined sleeve clutch type – Constructional details and principle of working mechanism ratchet and pawl arrangement mechanism –Constructional details and principle of working mechanism. Gears—Necessity for providing gear box, Selective sliding type, constant mesh type, Mechanical advantage in gears, torque ratio in gears, working of gear box. Differential



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unit and final drive–Differential, functions of crown wheel, differential lock, functions, final drive– functions of final drive.

#### **UNIT-IV**

Fluid coupling and torque connector, brake mechanism, requirements of good braking systems, classification of brakes, Mechanical brake and hydraulic brake– Working mechanism. Steering mechanism–Qualities of steering mechanism, main parts of steering mechanism types of steering boxes, working of hydraulic steering. Hydraulic control system – Working principals, basic components of hydraulic system – Types of hydraulic system, position control, draft control, mixed control, precautions for hydraulic system.

#### **UNIT-V**

Tractor power outlets – P.T.O., construction details; Belt pulley constructional details, tractor power outlet, drawbar, construction details. Traction-Traction efficiency, method for improving traction, coefficient of traction, rolling resistance, wheel slip or track slip, Rimpul - crawler tractor. Tractor testing – Preparation for tests, types of tests, test at the main power take off, test at varying speeds at full load, test at varying load, belt or pulley shaft test, drawbar test, tractor engine performance. Determination of centre of gravity, Suspension method, balancing method, weighing method. Tractor chassis machines, functions of chassis frame. Tractor chassis – Mechanics of tractor chassis.

#### **TEXTBOOKS**

1. Farm Tractor Maintenance and Repair. Jain. S.C. and Roy C.R.1984. TMH Publishing Co.Ltd., New Delhi.
2. Tractors and their power units. Lijedhal J.B.Carleton W.M.Turnquist P.K. and Smith D.W.1984.AVI PublishingCo. Inc., Westport, Connecticut.

#### **REFERENCES**

1. Farm Gas Engines and Tractors. Fred J.R.1963.AlliedPublisherPvt. Ltd., Bombay.
2. Farm Machines and their Equipment. Nakra C.P., 1986. Dhanpet RaiandSons.1982 Nai Sarak, New Delhi.



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<b>III Year I Semester</b>	<b>FARM MACHINERY AND EQUIPMENT - I</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Objective:** To understand primary and secondary tillage implements along with earth moving machinery. Seeding and plant protection equipment will be discussed to get awareness on the mechanical area of the agricultural engineering.

#### **UNIT-I**

Objectives of farm mechanization, sources of farm power, classification of farm machines. Materials of construction and heat treatment. Principles of operation and selection of machines used for production of crops - Field capacities of different implements and their economics. Problems on field capacities and cost of cultivation.

#### **UNIT-II**

Classification and types of tillage. Primary tillage implements - Moldboard plough and its parts, disc plough, and other ploughs. Secondary tillage equipment - Disc harrows, implements - Cultivators, and intercultural implements. Forces acting on tillage tools. Problems on forces analysis, draft measurement of tillage equipment. Draft and unit draft related calculations and workout with exercises.

#### **UNIT-III**

Earth moving equipment - Terminology, earth moving equipment, construction and their working principles. Earth moving equipment - Shovels, bulldozers. Earth moving equipment - Trenches and elevators.

#### **UNIT-IV**

Seeding methods, different types of seed metering mechanism, different types of furrow openers. Calibration of seed drills. Adjustment of seed drills. Objectives and uses of plant protection equipment. Types of sprayers and dusters. Sprayers calibration and selection. Constructional features of different components of sprayers and dusters and their adjustments.

#### **UNIT-V**

Transplanting methods, different types of transplanting machinery and their working principle, adjustments in transplanting equipment. Fertilizer application equipment – Fertilizer metering mechanism, calibration of fertilizer equipment.

#### **TEXTBOOKS**

1. Farm Machinery, Stone A A 1958. John Wiley and Sons, New York.
2. Farm Machinery and Equipment, Smith H P 1971. Tata McGraw-Hill Publishing Co. Ltd, New Delhi.



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**REFERENCE BOOKS**

1. Principals of Agricultural Engineering, Michael A M and OJha T P 1985  
Vol. I, Jain Brothers, New Delhi.
2. Principals of Farm Machinery, Kepner R A, Bainer R and Barger E L 1987.  
CBS Publishers and Distributors, Delhi.
3. Elements of Agricultural Engineering, Jagadeshwar Sahay 1992. Agro Book Agency,  
Patna.
4. Land Reclamation Machinery, Borshahov Mansurov Sergecv 1988. Mir Publishers,  
Moscow.

**Course Outcome**

- CO1: Apply principles of farm mechanization to calculate field capacities and  
cost of cultivation
- CO2: Calculate the forces acting on tillage tools, draft and unit draft
- CO3: Explain earth moving equipment
- CO4: Analyze seeding methods, plant protection equipment
- CO5: Discuss the features of transplanting machinery and fertilizer application equipment



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<b>III Year I Semester</b>	<b>SOIL AND WATER CONSERVATION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>ENGINEERING</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Objective:**

To enable the students to acquire knowledge on different soil laws estimation models, run off estimation by rational, curve number, cook's etc. Land use, capability classification, soil conservation measures like contour bunding, terracing, bench terraces, contour trenches and their types and complete design calculations. Also, to enrich the students and familiarize the students in the design of various gully control structures, temporary and permanent, their designs with a due importance to hydrologic, hydraulic and structural phases of design.

**UNIT-I**

Runoff – Factors affecting runoff – Peak Runoff and design peak runoff – its estimation - Rational method – Time of concentration & its estimation – Curve number method – Cook's method. Land use capability classification based on different criteria with a special reference to slope.

**UNIT-II:**

Introduction – Soil and water conservation research in India–Its sub-centers–Soil erosion–Geologic, Types & erosion procedures Accelerated types. Causes and agents of erosion – Factors affecting erosion – Water Erosion–Forms of water erosion – Mechanics of Erosion - Different stages of erosion – Rill – Sheet – Gully and Ravines—Gully erosion of classification, stages of gully development. Soil Loss estimation–Universal Soil Loss equation and modified soil loss equation, Explanation of various terms – Estimation of their various parameters. Erosion control measures – Agronomic and mechanical or engineering measures.

**UNIT-III:**

Wind Erosion – Factors affecting wind erosion, mechanics of wind erosion, Wind erosion control measures – Vegetative, mechanical measures, wind blades and shelter belts, sand dunes stabilization – Wind erosion and its control.

**UNIT-IV:**

Contour bunds – Design of contour bunds – Horizontal interval – Vertical interval – Cross section of the contour bunds – Seepage line consideration. Determination height of bund – Loss of area due to bunding. Design of waste weir – Construction of contour bunds in fields. Graded bunds – Design of graded bunds. Introduction to Conservation Ditching. Contour trenching – Staggered and continuous trenches – Adaptability and types. Terraces – classification of terraces - Design of narrow based and broad-based terraces. Bench Terraces – Types of bench terraces – Derivation of an equation for finding of vertical interval – Design of bench terraces.

**UNIT-V:** Vegetated water ways – Types of water ways based on shapes – Expression for wetted perimeter – C/S areas – Hydraulic radii – types of vegetation – roughness of different grasses –Design of vegetated water ways. Sedimentation – Sedimentation in reservoirs in streams, estimation and measurement, sediment delivery ratio, trap efficiency – Estimation of useful life of reservoir based on sedimentation. Characteristics of contours and preparation of



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contour maps for water area estimation, Volume calculation – Stage –Volume relationship structures for water harvest, Analysis of topo sheets. Introduction to water harvesting techniques – Earthen dams etc. Design of WH Structures, - Farm Pond, Percolation tanks, Check dams, Earthen dams etc. –Introduction to Stream water quality and pollution. Temporary gully control structures – Design – Types like Brush wood dams – Wire Mesh – Dams etc. – Introduction to permanent gully control structures – Design phases – Components of permanent structures. Machining used in earthwork – Estimate preparation for all structures. Goud Schemes or NRM activities and their objectives.

**TEXTBOOKS:**

1. Soil and Water Conservation Engineering. Swab G.O. Frevert R.K. Edminster T.W. and Barnes K.K. 1981 John Wiley and Sons New York.
2. Manual of Soil and Water Conservation Practical. Gurmel Singh. Venkataramanam C. Sastry G and Joshi BP. 1994.Oxford and IBH Publishing Co. Ltd., New Delhi.

**REFERENCEBOOKS:**

1. Land and Water Management Engineering. Murthy VVN 2004. Kalyani Publishers, New Delhi.
2. Introduction to Soil and Water Conservation Engineering. Mal B.S. 1995 Kalyani Publishers, Rajinder Nagar, Ludhiana.
3. Reddy, K.S. Manual on “Farm Ponds: A climate resilient technology in Rainfed Agriculture:
4. Design Planning and construction. ICAR, CRIDA Publications; [www.crida.in](http://www.crida.in).

**Course outcomes:**

Upon successful completion of this course, learner will be able to:

CO1: Calculate Peak run off, time of conservation

CO2: Estimate soil loss by using Universal Soil Loss equation and modified soil loss equation,

CO3: Discuss factors affecting wind erosion, mechanics of wind

CO4: Design contour bunds, graded bunds and bench terraces

CO5: Design vegetated water ways, WH Structures



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<b>III Year I Semester</b>	<b>GROUND WATER HYDROLOGY, WELL AND PUMPS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVE:** To enable the students to acquire knowledge on aquifers and estimation of their different properties like hydraulic conductivity, transmissibility, storage coefficient, specific yield, leakage factor, hydraulic resistance under steady and unsteady state conditions in wells dug under different aquifers, well drilling and development methods and equipment design of gravel pack in bore well. Further to make the students to acquire knowledge on various pumps available commercially, their selection, operation and maintenance with due importance to find out the cost of operation.

**OUTCOMES:**

- Skill development on principles of ground water resources development, different acquaintance and their principles.
- Imparting knowledge on theory of open well hydraulics and drilling methods.
- Skill development on aquifers characteristics under steady and unsteady state conditions, multiples well systems for coastal areas.
- Knowledge development to students on artificial ground water recharge classification of indigenous pumps, solar pumps, wind mill pumps etc.,
- Skill development on principles of Centrifugal pumps, principles & characteristics, High lift pumps, mixed flow pumps and vertical turbine pump sets.

**UNIT-I**

Water resources status of India-Occurrence and Movement of ground water and aquifers- Types of water bearing formations – Unconfined, confined, semi confined aquifers Perched water table condition-Diagrammatic representation.

**UNIT-II**

Classification of wells – Design of open wells – Ground water replenishment – Ground water exploration – Methods of drilling of wells – Common well drilling difficulties Gravel packing – well screens – Development of well.

**UNIT – III**

Aquifer characteristics - Influencing yield of wells - Determination of aquifer parameters – Steady state and unsteady state conditions – Well interference and multiple well point systems in coastal areas.



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**UNIT – IV**

Surface and subsurface exploitation and estimation of ground water potential –Artificial ground water recharge – Ground water project formulation–Classification of indigenous pumps – Wind powered water lifts – Solar powered and bio gas operated water lifts  
Reciprocating pumps.

**UNIT – V**

Centrifugal pumps – Terminology on horse power – Selection of pump installation and troubleshooting of pumps – Performance characteristic curves – Effect of change of impeller dimensions on performance characteristics. Hydraulic ram– Propeller pumps - Mixedflowpumps-Airliftpumps–Priming–Verticalturbinepumps–Submersiblepumps. Cost economics.

**TEXTBOOKS**

1. Ground Water and Tube Wells-Garg SP1985. Oxford and IBH publish in company limited, New Delhi.
2. Water Well land Pump Engineering–Michael AM and Khepar ST1989 Tata McGraw-Hill Publishing company limited, New Delhi.

**REFERENCES**

1. Irrigation Theory and Practice–Michael AM2008 Vikas Publishing House Pvt.Ltd, New Delhi.



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<b>III Year I Semester</b>	<b>SURFACE WATER HYDROLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Objective:** To enable the students to acquire knowledge and skills on hydrological (rainfall and runoff) measurements in watersheds, hydrological design of structures, prediction of volume and rates of runoff with tools like hydrographs and unit hydrographs, reservoir planning with flood routing techniques for application in natural resources management.

### **UNIT-I**

Hydrology - Definition, hydrology cycle and its components. Forms of precipitation rainfall, characteristics of rainfall in India (types of monsoons). Measurement of rainfall – Recording and non-recording rain gauges, rain gauge network density for different topographic conditions, point rainfall analysis. Presentation of rainfall data mass curve and hyetograph, mean precipitation over an area – Arithmetic mean, Thiessen polygon, isohyetal methods, DAD relationships and curves. Probability analysis of rainfall – Return period, plotting position by Weibull's method, rainfall events at different probability levels (20%, 40%, 60%, 80%).

### **UNIT-II**

Intensity-duration-frequency relationship, determination of net effective rainfall, infiltration indices, Phi index. Runoff – Definition, components of runoff, direct runoff and base flow, overload flow and interflows, pictorial representation of different routes of runoff. Runoff characteristics of streams – Perennial, intermittent and ephemeral streams, measurement of stream flows. Measurement of stage and velocities, staff gauge, wire gauge, automatic stage recorders, current meters (horizontal and vertical axis meters), calibration ( $V = a N_s + b$ ). Rainfall-runoff relations ( $R = a P + b$ ), curve fitting and determination of 'a' and 'b' and (correlation coefficient), factors affecting runoff. Definition and estimation of peak runoff and design peak runoff rate, rational method and curve number techniques.

### **UNIT-III**

Hydrographs - Definitions and components, factors affecting flood hydrographs, hydrograph separation for simple and complex storms – Method I (straight line method,  $N = b A^{0.2}$ ), other Methods II and III. Unit hydrographs - Concept and the three implications of the definitions and the two basic assumptions (linear response and time invariance). Effects of the characteristics of storms (duration of rain, time-intensity pattern, areal distribution of runoff and amount of runoff) on the shape of the resulting hydrographs. Derivation of unit hydrographs, average unit hydrographs from several storms of the same duration (proper procedure of computing average peak flow and time to peak). Derivation of unit



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hydrographs for complex storms.

#### **UNIT-IV**

Conversion of unit hydrograph duration, methods for unit hydrographs of different durations, method of superposition and S-curve. S-curve method, explanation of concept and application. Conversion of unit graph duration by S-curve method, determination of lower duration graph from the given higher duration graph and vice-versa. Synthetic unit hydrograph, concept, Snyder' synthetic unit hydrograph, formulas relating hydrograph features (basin lag, peak flow and time base of the unit hydrograph). Instantaneous unit hydrograph, concept and application, SCS triangular hydrograph, application of hydrology, flood control and regulation, flood mitigation, floodplain mapping, retards.

#### **UNIT V**

Flood routing - Introduction, two broad categories of flood routing and channel routing, hydrologic routing and hydraulic routing, basic equations. Hydrologic storage routing, schematic representation of storage routing, modified Pul's method (semi-graphical method). Explanation of the features of the modified Pul's method. Flood routing through a reservoir by modified Pul's method. Applications of hydrology in land and water management, watershed management.

#### **TEXTBOOKS**

1. Engineering Hydrology. Raghunath H M, 1986. Willey Eastern Limited, New Delhi.
2. Watershed Hydrology, Suresh R, 1997. Standard Publisher and Distributors, New Delhi.

#### **REFERENCE BOOKS**

1. Engineering Hydrology. Subramanyam K, 1984. Tata McGraw-Hill Publishing Co. Limited, New Delhi.
2. Hydrology for Engineers, Linsley R K, Kholer A and Paul Hus J L H, 1988, McGraw- Hill Book Co., New Delhi.
3. Watershed Management. Dhruvanarayana, V V, 1990. ICAR Publication, New Delhi.

#### **Course Outcome**

- CO1: Analyze probability of rainfall, return period, plotting position  
CO2: Determine net effective rainfall, peak runoff and peak runoff rate  
CO3: Discuss the factors affecting flood hydrographs, hydrograph Separation for simple and complex storms  
CO4: Describe method of superposition, S-curve and determine duration  
graphs  
CO5: Use the concepts of flood raining



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<b>III Year I Semester</b>	<b>AGRICULTURAL PROCESS ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Objective:** To train students on unit operations of agricultural process engineering to acquaint with preliminary operations such as clearing, size reduction, mixing, separation, filtration and materials handling equipment.

### **UNIT-I**

Scope and importance of material handling devices, study of different material handling systems – Classification, principles of operation, conveyor systems selection/design. Belt Conveyor – Inclined belt conveyors, idler spacing, belt tension, drive tension, belt tripper. Chain conveyor – Principle of operation, advantages, disadvantages, capacity and speed, conveying chain. Screw conveyor – Principle of operation, capacity, power, troughs, loading and discharge, inclined and vertical screw conveyors. Bucket elevator – Principle, classification, operation, advantages, disadvantages, capacity, speed, bucket discharge, relationship between belt speed, pickup and bucket discharge, bucket types. Pneumatic conveying system - Capacity and power requirement, types, selection of pneumatic conveying system. Gravity conveyor - Design considerations, capacity and power requirement. Size reduction – Principle of comminution/size reduction, mechanisms of comminution of food, particle shape, average particle size, characteristics of comminuted products, crushing efficiency. Determination and designation of the fineness of ground material, screen analysis, empirical relationships (Rittinger's, Kick's and Bond's equations), work index, energy utilization. Methods of operation of crushers, classification based on particle size, nature of the material to be crushed. Size reduction equipment: Principal types, crushers (jaw crushers, gyratory, smooth roll), hammer mills and impactors, attrition mills, burr mill, tumbling mills, action in tumbling mills. Size reduction equipment – Ultra fine grinders (classifying hammer mills, fluid energy mill, micronizer fluid jet pulverizer, colloid mill), cutting machines (slicing, dicing, shredding, pulping), energy requirement of size deduction, energy requirement of cutting operation, maintenance of cutting edges.

### **UNIT-II**

Mixing – Introduction, theory of solids mixing, criteria of mixer effectiveness and mixing index for granular solids, mixing indices, mixing of widely different quantities, criteria of mixer effectiveness and mixing index for pastes and semi- solid masses, mixing index at zero-time, rate of mixing, theory of liquid mixing, power requirement for liquids mixing. Mixing equipment – Mixers for low or medium viscosity liquids (paddle agitators, impeller agitators, powder-liquid contacting devices, other mixers), mixers for high viscosity liquids and pastes, mixers for dry powders and particulate solids.



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### **UNIT-III**

Theory of separation, types of separators, cyclone separators, size of screens and applications, separator based on length, width, and shape of the grains, specific gravity, density. Air-screen grain cleaner - Principle and types, design considerations of air-screen grain cleaners, sieve analysis, particle size determination, ideal screen and actual screen, effectiveness of separation and related problems. Pneumatic separator, threshing, winnowing, cleaning and separation equipment.

### **UNIT-IV**

Moisture content and methods for determination in grains, moisture content representation, wet basis, dry basis, direct and indirect methods of moisture content determination, calculations and workout with exercises. Importance of EMC and method of determination, static-dynamic methods, EMC curve and EMC models, hysteresis effect, bound, unbound and free moisture. Principles of drying, theory of diffusion, mechanism of drying, falling rate, constant rate period. Thin-layer, deep bed drying methods. Effect of different factors on the drying process, different types of dryers, LSU dryer, flat bed batch dryer, fluidized bed dryer, rotary dryer, solar dryer.

### **UNIT-V**

Theory of filtration, rate of filtration, pressure drop during filtration, applications, Constant-rate filtration and constant-pressure filtration derivation of equation, Filtration equipment - Plate and frame filter press, rotary filters, centrifugal filters and air filters.

### **TEXTBOOKS**

1. Transport Processes and separation Process Principle, Geankoplis C J 2003  
Prentice-Hall Inc., New Jersey.
2. Unit operations in Food processing, Earle R L 1983. Pergamon Press, New York

### **REFERENCE BOOKS**

1. Post-Harvest Technology of Cereals, Pulses and oil seeds, Chakraverty A 1988.  
Oxford and IBH Publishing Co. Ltd, Calcutta.
2. Unit Operations of Chemical Engineering, McCabe W L, Smith J C and Harriott P  
1993 McGraw-Hill Book Co., Boston.

### **Course Outcome**

Upon successful completion of this course, learner will be able to

CO1: Discuss different types of material handling devices

CO2: Analyze the effectiveness and mixing index for granular solids, mixing indices

CO3: Explain aerodynamics of agricultural product

CO4: Estimate moisture content in wet basis and dry basis for different types of grains



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<b>III Year I Semester</b>	<b>ENGINEERING PROPERTIES OF AGRICULTURAL PRODUCE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**Objective:** To enable the students to understand the basic concepts of application of engineering properties of biological material, rheology, basic concepts, classification of rheology, flow behavior of biological materials, measurement of viscosity using viscometer, types of viscometer, workout exercises on viscometer, rolling resistance, angle of internal friction and angle of repose, applications of frictional properties in design of processing equipment, specific heat, thermal conductivity, thermal diffusivity, latent heat of vaporization, latent heat of fusion, sensible heat, enthalpy and heat energy calculation.

#### **UNIT-I**

Physical properties - Introduction and application of engineering properties of biological material. Physical properties of different food commodities and aided products – importance. Shape and size – Criteria for describing shape and size. Roundness and sphericity, volume and density, specific gravity, bulk density, porosity, surface area and measurement of these properties.

#### **UNIT-II**

Rheology - Introduction to rheology, basic concepts, classification of rheology, ASTM standard definition of terms. Rheological properties, flow behavior of biological materials, force deformation curve, linear elastic limit, yield point, bio-yield point and rupture point. Stress relaxation and creep behavior. Visco-elasticity and visco-plasticity.

#### **UNIT-III**

Rheological models - Introduction to mechanical models, Kelvin and maxwell models. Electrical equivalence of mechanical models. Rheological equations of maxwell model, generalized Maxwell model, Kelvin model and generalized Kelvin model. Difference between Kelvin and Maxwell model. Viscosity - Measurement of viscosity using viscometer, types of viscometers, workout exercises on viscometer.

#### **UNIT-IV**

Frictional Properties - Basic concepts, effect of load sliding velocity. Friction in agricultural materials, measurement. Rolling resistance, angle of internal friction and angle of repose. Applications of frictional properties in design of processing equipment. Aerodynamic properties - Importance of aerodynamic properties in agricultural processing equipment with examples. Terminal velocity and drag coefficient, frictional drag and profile drag or pressure drag. Terminal velocity of different grains, working of pneumatic conveyor based on aerodynamic properties.

#### **UNIT-V**

Electrical properties – Di-electrical properties, dielectric loss factor and dielectric constant. Applications and role of electrical properties in food processing. Thermal Properties - Introduction to thermal properties, specific heat, thermal conductivity, thermal diffusivity, latent heat of vaporization, latent heat of fusion, sensible heat, enthalpy and heat energy calculation.



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**TEXTBOOKS**

1. Physical properties of plant and animal materials, Mohsenin N N, Gordon and Breach Science Publishers, New York, 2nd Edition, 1986.
2. Engineering Properties of Foods, Rao M A, Syed S H Rizvi and Ashim K Datta, CRC Press – Taylor & Francis Group, Boca Raton, FL, 4th Edition, 2014

**REFERENCE BOOKS**

1. Food and Process Engineering Technology, Wilhelm LR, Suler W A and Brusewitz, G H, American Society of Agricultural Engineers (ASAE), St. Joseph, MI.
2. Engineering Properties of Biological Materials, O.P. Singhal and D.V.K. Samuel, Saroj Prakashan, Allahabad, 1st Edition, 2003.

**Course Outcome**

At the end of the course, student will be able to

CO1: Calculate the basic engineering properties of a biological material

CO2: Analyze the flow behavior of biological materials and force deformation

CO3: Analyze the Maxwell and Kelvin model equations in the rheology for important biological materials

CO4: Explain the applications of frictional and aerodynamic properties in the design of processing equipment

CO5: Explain the applications of electrical and thermal properties in the design of processing equipment



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<b>III Year - I Semester</b>	<b>GREENHOUSE TECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>(Professional Elective - I)</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**Objective:** Constructional and operational details of greenhouses will lead the students to grow crops with profits and also to use the greenhouses for off-season usage and also to manage them commercially.

#### **UNIT-I**

Greenhouses – Introduction, history, definition, greenhouse effect, advantages of greenhouses. Classification of greenhouses – Greenhouse types based on shape, utility, construction and covering material. Plant response to greenhouse environment – Light, temperature, relative humidity, ventilation and carbon dioxide.

#### **UNIT-II**

Environmental requirement for crops – Temperature requirement of horticultural crops, light requirement of crops and lighting control methods. Greenhouse shading methods, greenhouse supplemental lighting systems. Environmental control inside greenhouse – Manual controlling, thermostats, microprocessors and computerized control systems.

#### **UNIT-III**

Natural and forced ventilation summer and winter cooling systems, carbon dioxide enrichment method. Planning of greenhouse facility – Site selection and orientation, structural design. Materials used for construction of greenhouses – Wood, galvanized iron pipe and glass. Greenhouse covering materials – Polyethylene film, PVC, polyester, Tefzel T2 film, polyvinyl chloride rigid panel, fiber glass reinforced plastic rigid panel, acrylic and polycarbonate rigid panel. Design criteria and construction details of glass and pipe framed greenhouses, material requirement and procedure for erection.

#### **UNIT-IV**

Greenhouse heating and energy storage – Type of heat loss, heating systems, heat distribution systems, water and rock storage, heat conservation practice. Greenhouse irrigation systems – Rules of watering, hand watering, perimeter watering, overhead sprinklers, boom watering, dripirrigation.

#### **UNIT-V**

Greenhouse utilization in off-season – Drying of agricultural produce. Protected agriculture techniques – Row covers. Economics of greenhouse production – Capital requirements. Economics of production and conditions influencing returns.



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**TEXTBOOKS**

1. Greenhouse technology and Application, Vilas M. Salone and Ajay K. Sharma  
Agrotech Publishers, New Delhi, 2012
2. Greenhouse Technology for controlled Environment, Tiwari, G.N. Narsoa Publishing  
House Pvt. Ltd.
3. Greenhouse Technology- Management, Operation and Maintenance, N.N Patil,  
UniversalPrakashan Publisher.

**REFERENCE BOOKS**

1. Greenhouse Technology and Management, Radha Manohar K and Igathinathane C 2nd  
Edition, BS Publication.
2. Advances in Protected Cultivation, Singh Brahma and Balraj Singh, New India  
PublishingCompany, 2014.
3. Greenhouse Management of Horticulture Crops, S Prasad and U Kumar, Second  
Edition, Agrobios, New Delhi, 2012.
4. Greenhouse: Advanced Technology for Protected Horticulture, J Hanan, CRC Press,  
LLC,Florida, 1998.

**Course Outcome**

At the end of the course, student will be able to

CO1: Classify the greenhouses based on different parameters

CO2: Identify the required environmental factors for crop growth

CO3: Analyze the natural and forced ventilation, summer and winter cooling systems

CO4: Explain greenhouse irrigation systems

CO5: Describe protected agricultural techniques



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**R23 AGRICULTURAL ENGINEERING COURSE STRUCTURE & SYLLABUS**

<b>III Year - I Semester</b>	<b>TRACTOR DESIGN AND TESTING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>(Professional Elective - I)</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**Objects:** To enable the students to know the development of agricultural tractors and different operations performed by the tractors. To know the different trouble shootings and remedies, design of different parts. To get knowledge on different tests performed on tractors.

#### **UNIT-I**

Procedure for design and development of agricultural tractor, classification, selection. Study of parameters for balanced design of tractor for stability and weight distribution, traction theory, hydraulic lift and hitch systems design.

#### **UNIT-II**

Complete drive train, transmission. Design of mechanical power transmission in agricultural tractors - Single disc, multi disc and cone clutches. Rolling friction and anti-friction bearings.

#### **UNIT-III**

Design of Ackerman steering and tractor hydraulic steering. Study of special design features of tractor engines and their selection viz. cylinder, piston, piston pin, crankshaft, etc. Design of seat and controls of an agricultural tractor. Tractor testing.

#### **UNIT-IV**

Design calculation exercises on tractor clutch – (Single/multiple disc clutch). Design of gear box (synchromesh/constant mesh), variable speed constant mesh drive. Selection of tractor tyres –Calculation exercises. Calculation exercises on design of governor. Design and selection of hydraulic pump. Engine testing as per BIS code.

#### **UNIT-V**

Drawbar performance in the lab. PTO test and measure the tractor power in the lab/field. Determining the turning space, turning radius and brake test, hydraulic pump performance test and air cleaner and noise measurement test. Visit to tractor testing Centre/industry.

#### **TEXTBOOKS**

1. Maleev V L, 1964. Internal Combustion Engines, Tata McGraw-Hill, USA
2. Richey C B, 1991. Agricultural Engineering Handbook. McGraw-Hill, USA

#### **REFERENCE BOOKS**

1. Liljedahl J B, Carleton W M, Turnquist P K and Smith D W, 1984. Tractors and their Power Units. AVI Publishing Co. Inc., Westport, Connecticut.
2. Raymond N, Yong E A and Nicolas S, 1984. Vehicle Traction Mechanics, Elsevier Scientific Publications, USA.
3. Kirpal Singh. 2012. Automobile Engineering – Vol I and Vol II. Standard Publishers,



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Delhi.

4. Mehta M L, Verma S R, Mishra S K, Sharma V K, 2005. Testing and Evaluation of Agricultural Machinery, Daya Publishing House, New Delhi.

**Course Outcome**

At the end of the course, student will be able to

CO1: Analyze parameters for balanced design of a tractor

CO2: Explain the elements of mechanical power transmission in agricultural tractor

CO3: Design seat controls of an agricultural tractor

CO4: Design gear box

CO5: Determine turning space, turning radius and other parameters associated



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<b>II Year - I Semester</b>	<b>FARM MACHINERY AND EQUIPMENT -</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>I LAB</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>

**Objective:** To enable the student to get the practical knowledge on various operation in agricultural field for crop production.

### **Practical**

1. Study of various farm machinery and equipment
2. Visit to machinery production industry and ICAR, SAU research station
3. Determination of field capacity and field efficiency of primary tillage implements
4. Draft and fuel consumption measurement for different implements
5. Study of different types of plough bottoms and shares of M.B. Plough
6. Determination of disc angle, tilt angle, concavity of a disc plough
7. Calculation of draft and horse power
8. Study of seed-cum-ferti drill and seed metering mechanisms
9. Calibration of seed drill and calculation exercises
10. Study of sprayers, dusters and measurement of nozzle discharge and field capacity
11. Study of earth moving equipment through exposure visit
12. Construction and working of rotovators and weeding equipment

### **TEXTBOOKS**

1. Principles of Farm Machinery. Kepner R.A., Bainer, R and Barger E.L., 1987. CBS Publishers and Distributors, Delhi.
2. Elements of Agricultural Engineering. Jagadeshwar Sahay. 1992. Agro Book Agency, Patna.

### **REFERENCE BOOKS**

1. Farm Machinery. Stone A.A. 1958. John Wiley and Sons. New York.
2. Farm Machinery and Equipment. Smith H.P. 1971. Tata Mc Graw-Hills. Publishing Co. Ltd., New Delhi.
3. Principles of Agricultural Engineering, Vol. I. Michael A.M. and Ohja T.P. 1985. Jain Brothers, New Delhi.
4. Land Reclamation Machinery. Borshahov Mansurov Sergeev 1988 Mir Publishers, Moscow.

### **Course Outcome**

- CO1: Study various implements and functional element  
CO2: Evaluate field efficiencies and fuel efficiencies  
CO3: Evaluate performance of various agricultural implements and machines  
CO4: Design and calibrate seed drills and matching mechanism



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**R23 AGRICULTURAL ENGINEERING COURSE STRUCTURE & SYLLABUS**

<b>III Year - I Semester</b>	<b>AGRICULTURAL PROCESS ENGINEERING LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>

**Objective:** To train the students on how to conduct experiments and evaluate performance of various agricultural food process

**Practical**

1. Preparation of flow charts and layout of a food processing plant
2. Determination of fineness modulus and uniformity index
3. Determination of mixing index of a feed mixer
4. Determination of the efficiency of cyclone separator
5. Tutorial on extraction by McCabe and Thiele plot
6. Tutorial on use of psychrometry chart
7. Tutorial Problems on distillation
8. Tutorial on power requirement in size reduction of grain using Rittinger's law, Kick's law and Bond's law
9. Performance evaluation of hammer mill and attribution mill
10. Separation behavior in pneumatic separation
11. Evaluation of performance of indented cylinder and screen pre cleaner
12. Mixing index and study of mixers

**TEXTBOOKS**

1. Transport Processes and separation Process Principle, Geankopolis C J 2003 Prentice-Hall Inc., New Jersey.
2. Unit operations in Food processing, Earle R L 1983. Pergamon Press, New York

**REFERENCE BOOKS**

1. Post Harvest Technology of Cereals, Pulses and oil seeds, Chakraverty A 1988. Oxford and IBHPublishing Co. Ltd., Calcutta.
2. Unit Operations of Chemical Engineering, McCabe W L, Smith J C and Harriott P 1993 McGraw-Hill Book Co., Boston.

**Course Outcome**

- CO1: Calculate uniformity and milling index  
CO2: Design the procedural calculation of cyclone and pneumatic separation  
CO3: Solve the calculation exercises on psychometric chart and on site reduction  
CO4: Conduct the performance evaluation of hammer and attribution mills



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<b>III Year - I Semester</b>	<b>STRUCTURAL DESIGN WITH ANSYS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>1</b>	<b>2</b>	<b>2</b>

**Objective:** To enable the students to understand the concepts of loads and use of BIS codes, design of singly and doubly reinforced sections, reinforced concrete cantilever and counter fort retaining walls, RC solid slab bridge, design of eccentric shear and moment resisting connections, method of IS code and structural steel framing

### **UNIT-I**

Loads and use of BIS Codes. Design of connections. Design of structural steel members in tension, compression and bending. Design of steel roof truss.

### **UNIT-II**

Analysis and design of singly and doubly reinforced sections, shear, bond and torsion. Design of flanged beams, slabs, columns, foundations, retaining walls and silos.

### **UNIT-III**

Retaining walls - Reinforced concrete cantilever and counter fort retaining walls. Horizontal backfill with surcharge – Design of shear key - Design and drawing.

### **UNIT-IV**

Flat slab and bridges - Design of flat slabs with and without drops by direct design method of IS code - Design and drawing - IRC Specifications and loading – RC Solid Slab Bridge – Steel Foot over Bridge - Design and Drawing. Liquid storage structures - RCC water tanks - On ground, elevated circular, underground rectangular tanks. Hemispherical bottomed steel water tank -- Design and Drawing

### **UNIT-V**

Industrial structures - Structural steel framing - Steel roof trusses – Roofing elements – Beam columns – Codal provisions - Design and drawing. Girders and connections: Plate girders – Behaviour of components - Design of welded plate girder - Design of industrial gantry girders – Design of eccentric shear and moment resisting connections.

### **Practical**

Design and drawing of single reinforced beam, double reinforced beam. Design and drawing of steel roof truss. Design and drawing of one-way, two-way slabs. Design and drawing of RCC building. Design and drawing of retaining wall. To measure workability of cement by slump test



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**TEXTBOOKS**

1. Junarkar, S.B. 2001. Mechanics of Structures Vol. I Charotar Publishing Home, Anand.

**REFERENCE BOOKS**

1. Kumar Sushil 2003. Treasure of R.C.C. Design. R.K. Jain. 1705-A, Nai Sarak, Delhi-110006, P.B.1074.
2. Khurmi R S, 2001. Strength of materials. S. Chand & Company Ltd, 7361, Ram Nagar, New Delhi – 110055.

**Course Outcome**

At the end of the course, student will be able to

CO1: Design of connections, structural steel members in tension, and compression and bending

CO2: Analyze singly and doubly reinforced sections, shear, bond and torsion

CO3: Design of reinforced concrete cantilever and counter fort retaining walls

CO4: Design of flat slabs with and without drops by direct design method of IS code

CO5: Design of eccentric shear and moment resisting connections



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**R23 AGRICULTURAL ENGINEERING COURSE STRUCTURE & SYLLABUS**

<b>III Year - II Semester</b>	<b>SURFACE WATER HYDROLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Objective:** To enable the students to acquire knowledge and skills on hydrological (rainfall and runoff) measurements in watersheds, hydrological design of structures, prediction of volume and rates of runoff with tools like hydrographs and unit hydrographs, reservoir planning with flood routing techniques for application in natural resources management.

### **UNIT-I**

Hydrology - Definition, hydrology cycle and its components. Forms of precipitation rainfall, characteristics of rainfall in India (types of monsoons). Measurement of rainfall – Recording and non-recording rain gauges, rain gauge network density for different topographic conditions, point rainfall analysis. Presentation of rainfall data mass curve and hyetograph, mean precipitation over an area – Arithmetic mean, Thiessen polygon, isohyetal methods, DAD relationships and curves. Probability analysis of rainfall – Return period, plotting position by Weibull's method, rainfall events at different probability levels (20%, 40%, 60%, 80%).

### **UNIT-II**

Intensity-duration-frequency relationship, determination of net effective rainfall, infiltration indices, Phi index. Runoff – Definition, components of runoff, direct runoff and base flow, overload flow and interflows, pictorial representation of different routes of runoff. Runoff characteristics of streams – Perennial, intermittent and ephemeral streams, measurement of stream flows. Measurement of stage and velocities, staff gauge, wire gauge, automatic stage recorders, current meters (horizontal and vertical axis meters), calibration ( $V = a N_s + b$ ). Rainfall-runoff relations ( $R = a P + b$ ), curve fitting and determination of 'a' and 'b' and (correlation coefficient), factors affecting runoff. Definition and estimation of peak runoff and design peak runoff rate, rational method and curve number techniques.

### **UNIT-III**

Hydrographs - Definitions and components, factors affecting flood hydrographs, hydrograph separation for simple and complex storms – Method I (straight line method,  $N = b A^{0.2}$ ), other Methods II and III. Unit hydrographs - Concept and the three implications of the definitions and the two basic assumptions (linear response and time invariance). Effects of the characteristics of storms (duration of rain, time- intensity pattern, areal distribution of runoff and amount of runoff) on the shape of the resulting hydrographs. Derivation of unit hydrographs, average unit hydrographs from several storms of the same duration (proper procedure of computing average peak flow and time to peak). Derivation of unit hydrographs for complex storms.



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#### **UNIT-IV**

Conversion of unit hydrograph duration, methods for unit hydrographs of different durations, method of superposition and S-curve. S-curve method, explanation of concept and application. Conversion of unit graph duration by S-curve method, determination of lower duration graph from the given higher duration graph and vice-versa. Synthetic unit hydrograph, concept, Snyder' synthetic unit hydrograph, formulas relating hydrograph features (basin lag, peak flow and time base of the unit hydrograph). Instantaneous unit hydrograph, concept and application, SCS triangular hydrograph, application of hydrology, flood control and regulation, flood mitigation, floodplain mapping, retards.

#### **UNIT V**

Flood routing - Introduction, two broad categories of flood routing and channel routing, hydrologic routing and hydraulic routing, basic equations. Hydrologic storage routing, schematic representation of storage routing, modified Pul's method (semi-graphical method). Explanation of the features of the modified Pul's method. Flood routing through a reservoir by modified Pul's method. Applications of hydrology in land and water management, watershed management.

#### **TEXTBOOKS**

1. Engineering Hydrology. Raghunath H M, 1986. Willey Eastern Limited, New Delhi.
2. Watershed Hydrology, Suresh R, 1997. Standard Publisher and Distributors, New Delhi.

#### **REFERENCE BOOKS**

1. Engineering Hydrology. Subramanyam K, 1984. Tata McGraw-Hill Publishing Co. Limited, New Delhi.
2. Hydrology for Engineers, Linsley R K, Kholer A and Paul Hus J L H, 1988, McGraw-Hill Book Co., New Delhi.
3. Watershed Management. Dhruvanarayana, V V, 1990. ICAR Publication, New Delhi.

#### **Course Outcome**

- CO1: Analyze probability of rainfall, return period, plotting position  
CO2: Determine net effective rainfall, peak runoff and peak runoff rate  
CO3: Discuss the factors affecting flood hydrographs, hydrograph Separation for simple and complex storms  
CO4: Describe method of superposition, S-curve and determine duration graphs  
CO5: Use the concepts of flood raining



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<b>III Year - II Semester</b>	<b>FARM MACHINERY AND EQUIPEMNT - II</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Objective:** To enable the students to understand the basic principles of cutting mechanisms and to know the various available harvesting machines. To know the working principle and functions of various machine parts of mowers, reapers, windrowers, forage harvesters, threshers, combine harvesters, cotton strippers, cotton pickers, groundnut and potato and sugarcane harvesters. Students can also understand the importance of testing and evaluation of agricultural machines and different standard codes (BIS) available in India for testing of machinery.

#### **UNIT-I**

Harvesting – Crop harvesting machinery, history of development, manual harvesting and its classification. Principles and types of cutting mechanisms – Principle of cutting mechanism, impact cutting, types of impact cutting, shear cutting Construction and adjustments of shear and impact type cutting mechanisms. Mowers – History and development, tractor mounted mowers, trail behind tractor mower, integral rear mounted mowers, side or central mounted tractor mower, semi-mounted mowers, safety precautions in operation and adjustments of mowers, knife drives, cutter bar and its parts – inside and outside shoes. Cutter bar – Guards, ledger plates, wearing plates, knife clips, grass board and various parts of cutter bar assembly, alignment and registration of cutter bar. Windrowing – Methods of windrowing, Self-propelled windrows, effects on yields and quality of reapers, animal drawn reaper, tractor mounted vertical conveyer reaper. Repairs and maintenance of harvesting equipment.

#### **UNIT-II**

Power operated vertical conveyer reapers – Reaper binders, care and maintenance, types. Forage harvesting equipment – Row forage harvesting equipment, field forage harvesters, types of field forage harvesters. Field chopper harvesters, forage wagons and boxes, field flail forage harvesters, self-propelled forage harvester, silo forage blowers, silo unloaders.

#### **UNIT-III**

Threshing – Principal of threshing, threshing methods, threshing by manual, threshing by animals, threshing by machines, Olpad threshers. Power thresher – Types of power threshers, hammer mill type, rasp bar, spike tooth, syndicator. Classification threshers based on feeding type, components of power thresher. Cleaning unit - Aspirator, blower, winnower, winnowing fan, cylinder adjustment. Wheat thresher, groundnut thresher, and terminology connected with power thresher. Development of the binder and development of the combine.

#### **UNIT-IV**

Harvesters, advantages and disadvantages of combines. Types of combines – Tractor drawn and self-propelled combines. Functions performed by a combine, cutting mechanism. Threshing harvesting equipment - Types of corn pickers, snappers, picker husker, Picker



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Sheller, power transmission, gathering and snapping mechanism, conveying and elevating mechanism. Husking mechanism, shelling mechanism, factors affecting performance of corn pickers, safety rules for operating corn pickers. Root crop harvesting equipment – Groundnut harvester, groundnut diggers, digger operation and adjustments, groundnut shakers, groundnut threshers and pickers, groundnut combines different units and its operation. Potato harvesters – Harvesting methods and equipment, one-row harvester, two-row harvester, digging and soil separation, vine removal by harvesters, separation of stones and clods.

#### **UNIT-V**

Cotton harvesting equipment – Cotton stripper, types of cotton strippers, factors affecting the performance of the cotton strippers, plant characteristics (thickness of plants), conveying system. Cotton pickers – Types of pickers, drum type and chain belt spindle arrangements in cotton pickers, methods of mounting spindles, doffing of the cotton, conveying systems, working, factors affecting performance of cotton pickers. Sugarcane harvesters – Self-propelled sugarcane harvester, cleaning, conveying and special sugarcane wagon. Principles of fruit harvesting tools and machines – Harvesting methods, manual harvesters, hold on and twist type, horticultural tools and gadgets. Testing of farm machine - Introduction, standardization efforts, testing programme and procedure, type of testing systems, national testing, prototype testing, testing for quality marketing.

#### **TEXTBOOKS**

1. Principals of Farm Machinery. Kepner R.A., Bainer R and Barger E.L, 1987. CBS Publishers and Distributors, Delhi.
2. Engineering principles of Agricultural machines, Ajith K Srivatsava, Carrol E. Goering, Roger P Rohrbach, 1993, ASAE Publishers.

#### **REFERENCE BOOKS**

1. Pesticide Application Equipment. Bindra O S and Hari Charansingh, 1971. Oxford and IBH Publishing Co. Ltd, New Delhi.
2. Farm Machinery and Equipment. Smith H P, 1971. Tata McGraw-Hills Publishing Co., Ltd., New Delhi.
3. Testing and Evaluation of Agricultural Machinery. Mehta M L, Verma S R, Misra S K and Sharma V K, Daya Publishing House, New Delhi.

#### **Course Outcome**

Upon successful completion of this course, learner will be able to

CO1: Describe crop harvesting machinery

CO2: Analyze the power operated vertical conveyer reapers

CO3: Apply the threshing principles for all types of threshers

CO4: Analyze the factors affecting the harvesters

CO5: Explain the features of cotton harvesting equipment



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**R23 AGRICULTURAL ENGINEERING COURSE STRUCTURE & SYLLABUS**

<b>III Year - II Semester</b>	<b>POST-HARVEST ENGINEERING OF CEREALS, PULSES AND OILSEEDS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Objective:** To enable the students to acquire knowledge and skills on cleaning and grading, aspiration, scalping, size separators, screens, sieve analysis, capacity and effectiveness of screens, milling of rice, milling of wheat, unit operations and equipment, milling of pulses - traditional milling methods, commercial methods, pre-conditioning, dry milling and wet milling methods, CFTRI and Pantnagar methods.

### **UNIT-I**

Cleaning and grading, aspiration, scalping. Cleaning and separation – Definition, objectives, requirements, contaminants in raw materials, characteristics for separation, screening, screen openings, aperture, screening equipment classification, screen interval, screen series, comparison of actual and ideal screens, material balance over screens, sieve analysis, capacity and effectiveness of screens. Cleaning and separation equipment – Separation based on size (fixed aperture and variable aperture), shape, pneumatic separation, specific gravity separation, separation based on surface texture, cyclone, shape graders, colour sorting. Air screen cleaner – Design considerations of air screen cleaner.

### **UNIT-II**

Rice milling – Definition, terminology related to rice. Rice processing – modern rice milling flowchart, layout of modern rice mill. Parboiling of paddy – Introduction, advantages, disadvantages, process variables, changes in chemical constituents. Parboiling – Starch gelatinization methods, parboiling operations, parboiling methods (traditional and modern), drying equipment. Rice husk and rice bran utilization – Commercial products and food products processing, uses of bran, instability of bran, stabilization of rice bran, factors affecting rate of formation of FFA. Rice milling – Terminology. Milling equipment – Engelberg huller, centrifugal sheller, under-runner disk husker, rubber roll sheller, husking action of rubber rolls, paddy separator (Satake type, Schule type), whiteners (Schele type, Satake type), rice grader. Rice processed food products – Introduction, manufacture process of rice noodles, puffed rice, oven puffed rice and pressure puffed rice, flaked and extruded products. Stabilization of rice bran.

### **UNIT-III**

Maize shelling and milling – Maize shellers (spring type, cylinder type). Dry milling – Cleaning, conditioning, degerming, reduction, classifying. Wet milling – Flow chart, cleaning, steeping, degerming, germ separation, germ oil, refining of oils, separation of hulls and fiber, gluten-starch separation. Extrusion cooking - Principle, factors affecting, single and twin-screw extruders.



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**UNIT-IV**

Wheat milling – Introduction, dry milling, unit operations (selection, blending, cleaning, conditioning/tempering, grinding/milling), Flour grades. Wet milling – Process.

**UNIT-V**

Milling of pulses – Introduction, composition and structure, important unit operations in pulse milling – cleaning, conditioning, dehusking and splitting, polishing of dhal and grading of dhal. Dry milling and wet milling methods - CFTRI and Pantnagar methods. Red gram – Process technology (methods) flow charts, equipment. Black gram and green gram process technology, flowcharts, equipment. Oilseed processing – Importance, concepts, oil expression and oil extraction, mechanical expression devices, hydraulic press, flow chart, screw press expeller configuration, radial and axial pressure in a barrel. Solvent extraction methods, batch immersion type, percolation type, continuous solvent extraction system, counter current extractor both mechanical and by solvent extraction. Refining of oil.

**TEXTBOOKS**

1. Chakraverty, A, Post Harvest Technology of cereals, pulses and oilseeds. Oxford & IBH Publishing Co. Ltd, New Delhi.
2. Dash S K, Bebartta J P and Kar A, Rice Processing and Allied Operations. Kalyani Publishers, New Delhi.

**REFERENCE BOOKS**

1. Earle R L, 2003. Unit Operations in Food Processing. Pergamon Press. Oxford, U.K.
2. Henderson S M, and Perry R L, Agricultural Process Engineering, Chapman and hall, London.
3. McCabe, W L, Smith J C and Harriott P, Unit Operations of Chemical Engineering. McGraw-Hill.
4. Singh R Paul and Heldman R Dennis, 2004. Introduction to Food Engineering, 3rd Edition. Academic Press, London.

**Course Outcome**

- CO1: Apply principles of separation of agricultural product  
CO2: Explain the processing of rice, wheat and maize  
CO3: Apply the principles of milling pulses and oilseeds  
CO4: Use CFTRI and Jadavpur methods for parboiling practices



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<b>III Year - II Semester</b>	<b>FOOD PACKAGING TECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Objective:** To provide knowledge on factors influencing spoilage of foods, packaging systems, different packaging materials, packaging equipment and packaging technology.

#### **UNIT-I**

Introduction to food packaging – Packaging situation in world and in India, definition of packaging - package, packaging, packing - need of packaging food, logistics, merchandising outlets, handling, transportation, packaging machinery, technology upgradation, public distribution, cost effective packaging, levels of packaging, functions of packaging, packaging environments, functions/environment grid.

#### **UNIT-II**

Shelf-life of processed foods: Factors influencing shelf-life of food products, package environment, hazards of distribution – mechanical, climatic and other hazards - and general principles of control of spoilage agents, packaging laws and regulations, FSSAI packaging and labeling regulations.

#### **UNIT-III**

Packaging materials – Classification of packages. Paper as packaging material - Types of paper, kraft paper, bleached paper, grease proof paper, glassine paper, vegetable parchment waxed paper, paper boards, paper board grades, folding cartons, kinds of carton boxes, beverage cartons, molded pulp containers, printing and varnishing, die cutting and creasing, gluing and sealing. Glass as package material - Composition of glass, parts of glass container closures, parts of closures, types of closures, properties of glass, internal pressure resistance, vertical load Strength, resistance to impact, resistance to scratches and abrasions. Glass manufacture - Press and blow, narrow neck press and blow, shape of glass container. Improvements in glass manufacturing - Hot and cold end treatment of surface. Inspection of glass bottles, advantages and disadvantages. Metal as packaging material – Introduction, manufacture of tin plate, tin plating manufacture of ECCS, manufacture of aluminium, advantages and disadvantages.

#### **UNIT-IV**

Packaging of milk and milk products - Packaging of fruits and vegetables, meat, fish and poultry, bakery and confectionary products, protein rich foods, packaging of edible starches and starch products, oils and fats, food grains and food grain products, sugar and honey, stimulant foods, alcoholic drinks and carbonated beverages, spices and condiments. Packaging of biscuits, milk powder, coffee, carbonated soft drink, fried snack foods. Package testing – Thickness, paper density, basis weight, grammage, burst strength, tear resistance, tensile strength, grease resistance, gas transmission rate, water vapour transmission rate.



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### **UNIT-V**

Container making processes - End manufacture, three piece can manufacture, welded side seams, soldered side seams, double seaming, two piece can manufacture, D&I cans, DRD cans, protective and decorative coatings. Aluminium foils and containers – Tube, retort pouch. Plastic consumption in India and world. Plastic packaging material - Classification of plastics, advantages and disadvantages polyethylene, low density polyethylene, linear low-density polyethylene, high density polyethylene, polypropylene, polystyrene, polycarbonate, polyvinyl chloride, polyvinylidene chloride, ethylene vinyl alcohol. Polyethylene terephthalate coating – Laminating and coating process.

### **TEXTBOOKS**

1. Food Packing Technology by Richard Coles and Mark J Kirwan, Wiley Blackwell Publishing. 2<sup>nd</sup> Edition. 2011
2. In-pack Processed Food by P Richardson, Woolhead Publishing, 1st Edition, 2008.

### **REFERENCE BOOKS**

1. Food Packaging Principles and Practices by Gordon L. Robertson, CRC Press, 3<sup>rd</sup> Edition, 2013.
2. Recent Innovation in Barrier Technology for Plastic Packaging, A Review by Jacob L. Packaging Technology and Sciences, 2003.
3. New Concept in Dairy Packaging by Varghes S and Goyal G K, Beverages

### **Course Outcome**

Upon successful completion of this course, learner will be able to

- CO1: Apply principles of packaging for cost effective packaging
- CO2: Estimate the Shelf-life of processed foods
- CO3: Describe different types of packaging materials
- CO4: Analyze the different techniques used for packaging of milk, fruits and meat.
- CO5: Explain various container making processes



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<b>III Year - II Semester</b>	<b>WATERSHED MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Objectives:** To train the students in the multi-disciplinary subject of watershed management for effective conservation of land, using engineering and agronomic practices, control of soil loss in watershed participatory management teams in small as well as large watersheds for increasing the productivity and preparation of necessary proposals.

#### **UNIT-I**

Watershed – Introduction and characteristics. Watershed development – Problems and prospects, investigation, topographical survey, soil characteristics, vegetative cover, present land use practices and socio-economic factors.

#### **UNIT-II**

Watershed management – Concept, objectives, factors affecting, watershed planning based on land capability classes, hydrologic data for watershed planning, watershed codification, delineation and prioritization of watersheds, sediment yield index. Water budgeting in a watershed.

#### **UNIT-III**

Management measures – Rainwater conservation technologies, in-situ and ex-situ storage, water harvesting and recycling. Dry farming techniques – Inter-terrace and inter-bund land management.

Integrated watershed management – Concept, components, arable lands – agriculture and horticulture, non-arable lands – forestry, fishery and animal husbandry.

#### **UNIT-IV**

Effect of cropping systems, land management and cultural practices on watershed hydrology. Watershed programme – Execution, follow-up practices, maintenance, monitoring and evaluation.

#### **UNIT-V**

Participatory watershed management – Role of watershed associations, user groups and self-help groups. Planning and formulation of project proposal for watershed management programme including cost-benefit analysis.

#### **TEXTBOOKS**

1. Ghanshyam Das. 2008. Hydrology and Soil Conservation Engineering: Including Watershed Management. 2nd Edition, Prentice-Hall of India Learning Pvt. Ltd., New Delhi.
2. Katyal J C, R P Singh, Shriniwas Sharma, S K Das, M V Padmanabhan and P K Mishra. Field 1995.



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**REFERENCE BOOKS**

1. Singh G D and T C Poonia. 2003. Fundamentals of Watershed Management Technology. Yash Publishing House, Bikaner.
2. Singh P K, 2000. Watershed Management: Design and Practices. E-media Publications, Udaipur.
3. Singh, R.V. 2000. Watershed Planning and Management. Yash Publishing House, Bikaner.
4. Tideman, E.M. 1999. Watershed Management: Guidelines for Indian Conditions. OmegaScientific Publishers, New Delhi.

**Course Outcome**

Upon successful completion of this course, learner will be able to

CO1: Plan for watershed development

CO2: Analyze the factors affecting the watershed management

CO3: Explain rainwater conservation technologies

CO4: Estimate the effect of cropping systems, land management and cultural practices on watershed hydrology

CO5: Prepare project proposal for watershed management programme including cost-benefit analysis



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<b>III Year - II Semester</b>	<b>HUMAN ENGINEERING AND SAFETY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Objective:** To enable the students to study of human relation with environmental factors, study of anthropometry study of safety gadgets for spraying, chaff cutting and tractor and trailer operator.

#### **UNIT-I**

Introduction to human engineering and safety - Human factors, machine factors, environmental factors, relationship between the three; study of human machine model, human performance, effectors and senses, importance of FMJ (Fitting Man Job) and FJM (Fitting Job Man). Study of anthropometrics in designs - Workspace design for standing and seated workers. Tasks requirements – Visual requirements and postural requirements.

#### **UNIT-II**

Functions of the skeletal and muscular systems - Conditions for the static equilibrium for the human body, the muscle function and types of muscle fatigue and discomfort. Factors influencing the work posture.

#### **UNIT-III**

Design of hand tools - Biometrics and energy for muscle contraction, oxygen dependent and oxygen independent system, CO<sub>2</sub> consumption, importance of cardio muscular system and respiratory system in physical work handling, difference between static and dynamic works.

#### **UNIT-IV**

Physical work capacity - Factors affecting the work capacity, introduction, work capacity personal factors - age and sex. Environmental factors - Light and climate. Indirect measures of energy expenditure, calculation of rest periods in manual work. Safety - Different machines and measures taken for the protection, vision - importance of vision, measures taken for the protection of the vision, guidelines for using colour combinations.

#### **UNIT-V**

Noise and vibration - Measurement of sound, the nature of sound, damages due to noise, preventive measures, displacer, types of displace, visual displace, audio signals, communication, noise communication, audio warning cues. Advance effects of air pollution - Safety regulation acts during field operations, safety measures. Rehabilitation and compensation to accident victims, human information processing, skill and performance, general model of human information processing, memory storage, short-term and long-term storages, feedback information, design of hand tools for agricultural operations.



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**TEXTBOOKS**

1. Work Study and Ergonomics, Dalela S and Saurabh 1995, Standard Publishers and Distributors, New Delhi.
2. New Horizons I - Human Factor Design, Huckingson 1992. McGraw-Hill Book Co., New Delhi.
3. Human Factors Engineering, McCormick E J 1992. McGraw-Hill Book Co., New Delhi.

**REFERENCE BOOKS**

1. Human Factors in Engineering and Design, Sanders M S and McCormick E J, 1992. McGraw-Hill Book Co., New Delhi.
2. Anthropometric Methods: Designing to Fit the Human Body by John A. Roebuck Jr. 1996. HFES Publications.
3. Anthropometric Sourcebook (1978). NASA Reference Publication No. 1024, Houston TX: NASA (NTIS, Springfield, VA 22161, Order No. 79 11734).

**Course Outcome**

Upon successful completion of this course, learner will be able to

CO1: Design workspace for standing and seated workers

CO2: Interpret the functions of the skeletal and muscular systems

CO3: Apply biometrics and energy for muscle contraction for the design of hand tools

CO4: Estimate the physical work capacity

CO5: Calculate sound, the nature of sound, damages due to noise



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<b>III Year - II Semester</b>	<b>IRRIGATION AND DRAINAGE ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**Objective:** To impose skills to students on surface and sub-surface drainage system, their concepts of design and keynotes for problem soils in irrigated agriculture.

### **UNIT-I**

Introduction irrigation engineering, advantages of irrigation, necessity and development of irrigation in India and AP and classification of irrigation projects. Irrigation terminology - GCA, CCA, Base period, crop period, delta, duty, relationship between duty and delta. Introduction to soil-water plant relationships, soil physical properties such as soil texture, soil structure, capillary conductivity, soil consistency-volume-mass relationships of soil constituents. Water relations with soil - Kinds of soil water-hygroscopic, capillary and gravitational movement of water into soils. Infiltration - Factors affecting infiltration, procedure for measurement of infiltration rate and development of infiltration equations (Kostia-Kov equations, Huston equations, curve fitting). Soil moisture characteristic curves, difference between soil moisture stress and soil moisture tension, soil moisture constants such as saturation capacity, field capacity moisture equivalent and permanent wilting point. Terminology related with movement of water within soils-water intake, percolation, interflow, seepage, permeability, hydraulic conductivity and hydraulic gradient- Measurement of soil moisture by different methods, evaporation, transpiration and evapo-transpiration- Estimation by Blaney-Criddle, Thornthwaite, Penman and modified Penman equations only- Potential ET. Water requirements of crops importance of water in plant growth, procedures net irrigation requirement (depth of irrigation), gross irrigation requirement, irrigation frequency and Irrigation efficiency (conveyance, application, storage, distribution, water use efficiency) with few numerical examples,

### **UNIT-II**

Gravity water application methods - Classification, border irrigation, components of border irrigation - width, length and slope for different soils for different soils. Hydraulics of border irrigation (advance curve, recession curve and opportunity time through time and distance curve), design of border irrigation. Derivation of Israelson's equation for the width of the border furrow irrigation system, advantages and disadvantages, determination of infiltration depth in furrows by inflow-outflow method (steam size, distance advance time, CS area and wetted perimeter data problem on computation of infiltration depth). Check basin irrigation – Advantages and disadvantages, estimation of infiltration under check basin conditions, adaptability and design considerations. Surge irrigation - Concepts, parameters, infiltration, hydraulics, efficiency and distribution uniformity.



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### **UNIT-III**

Conveyance of irrigation water - Methods assessment of design capacity of irrigation channels. Design of irrigation canals using Lacey's and Kennedy's theories and problems. Measurement of irrigation water-units of measurements, methods of measurement, direct and indirect methods, measurement of velocity using current meter-indirect methods such as area velocity method and coordinate method for measuring discharges from pipes, dethridge meter, tracer method. Direct methods of measurement of discharges - Different devices such as weirs, flumes and notches and their installation procedures, equations for rectangular triangular and trapezoidal notches, explanation on RBC flumes (critical flow flumes). Underground pipe lines for irrigation water distribution, types of pipes used for underground pipe lines, testing of pipes for its water absorption and pressure requirements, estimating the discharge capacity of pipe lines, installation procedures of underground pipe lines and study of different structures associated with underground pipe lines.

### **UNIT-IV**

Drainage - Definition, objective and types, familiarization with the drainage problems (twin problems of water logging and salinity) and extent of areas in irrigated areas in the state. Surface drainage - Effects of poor drainage, areas requiring drainage, factors affecting drainage requirement, drainage coefficient, determination of drainage coefficient based on different criteria. Types of surface drainage - Random field drain system, bedding system, parallel field drain, parallel lateral open ditch, cross slope drain system interception system, design of open drainage channels using Manning's equation and alignment of open ditches (radius of curvature), investigations on design parameters, hydraulic conductivity, drainable porosity fluctuations of depths to water table in the areas, methods of determining hydraulic conductivity - single auger hole method and inverse auger hole. Sub-surface drainage systems, purpose and benefits, types of sub surface systems, tile drains, mole drains, drainage wells, deep open drains and combinations and their suitability for different conditions and limitations.

### **UNIT-V**

Components of sub-surface drainage system. Layouts and types - Random type herring bone, grid iron cutoff or interceptor drains, depth and spacing of drains, size of the pipe drains using Manning's equation, drain materials of burnt clay. Perforated corrugated and solid PVC and cement concrete, slope/grade for the drains, Envelope materials for sub-surface drains and selection criteria for uniform soils and graded soils, geo-textile and nylon mesh, outlets for sub surface drainage, gravity and pumped outlets. Design of sub surface drains under steady state (equilibrium) conditions and derivation of Hooghoudt's equation for spacing, the Ernst's derivation for drain spacing, Glover-Dumm equation (only) for spacing under non-steady state conditions of water table, drainage structures, loads on conduits, ditch conduit conditions and projecting conduit conditions, construction and installation of drains, bio-drainage, vertical drainage and drainage of irrigated and humid areas, salt balance, classification and reclamation of saline and alkaline soils, soil amendments, leaching requirement-leaching ratio. Economic aspects of drainage with a typical example for total



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cost estimation of SSD system and benefit-cost ratio.

**TEXTBOOKS**

1. Irrigation Engineering, Muzumdar S K, 1983, Tata - McGraw-Hill Publishing. Co. Ltd, NewDelhi.
2. Irrigation Theory and Practice, Michael A M, 2008, Vikas Publishing House, New Delhi.

**REFERENCE BOOKS**

1. Drainage Engineering, Luthin J M, 1970, Wiley Eastern Ltd, New Delhi.
2. Soil and Water Conservation Engineering, Schwab G O, Frevert R K, Edminister T W and Barner K K, 1981, John-Wiley and Sons, New Delhi.
3. Land and Water management Engineering, Murthy V V N, 2004, Kalyani Publishers, New Delhi.

**Course Outcome**

At the end of the course, student will be able to

CO1: Explain the terminology related to Irrigation and calculate soil moisture by different methods

CO2: Determine infiltration under check basin conditions and adaptability

CO3: Design irrigation canals using Lacey's and Kennedy's theories

CO4: Describe the factors affecting drainage requirement, drainage coefficient based on the given criteria

CO5: Design subsurface drains under steady state conditions



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<b>III Year - II Semester</b>	<b>PRODUCTION TECHNOLOGY OF AGRICULTURAL MACHINERY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**Objective:** To enable the students to understand the different processes and machinery involved in manufacturing the agricultural machines and to acquire knowledge on CNC tooling, turning tools, milling tools, drilling tools, finishing tools. To know the industrial lay out, planning, organization, administration and management.

#### **UNIT-I**

Critical appraisal in production of agricultural machinery - Stresses in machine elements working stresses-stress analysis of machine parts by using standard software. Cutting tools including CNC tools and finishing tools-High speed steel cutting tools, cemented carbides, coated carbides, ceramics, drillingtools, types of drill bits, milling cutters.

#### **UNIT-II**

CNC tooling - Turning tools, milling tools, drilling tools, finishing tools associated with tool turrets, different types of tools used in CNC machining centers – vertical axis machining centers – twin turret tuning centre. CNC turning centers – Multiple spindles turning centers, integrated material handling.

#### **UNIT-III**

Powder metallurgy - Introduction, powder metallurgy process, preparation of metal powders. Characteristics of metal powders – Mixing compacting, sintering, hot pressing, applications of powder metallurgy. Limits fits and tolerances – Limits and fits compound tolerances, conditions for the success of any system of limits and fits, terms and definitions.

#### **UNIT-IV**

Jigs and fixtures – Jigs, fixtures, differences between jigs and fixtures, advantages of jigs and fixtures, essential features of jigs and fixtures. General rules for designing jigs and fixtures. Different types of jigs and types of fixtures. Controllers – CNC controlling for machine tools – motion control systems, pointto point control system, continuous path control system. CNC controlling for machine tools absolute incremental control system – open loop and closed loop system.

#### **UNIT-V**

Machine control unit – Introduction, configuration of machine control unit. Distributed numerical control, introduction and configuration. CNC part programming – Part programming fundamentals, manual part programming methods. CNC part programming – Interpretation of G codes, computer assisted part programming types, quality of good industrial management. Advantages of good organization – Economic order quantity, site



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selection of a factory, general location of a factory, plant lay out. Selection of stander and critical components for manufacturing agricultural machines. Case studies of manufacturing of agricultural machinery.

**TEXTBOOKS**

1. CAD/CAM: Principles and Applications, Rao P N, 2004, McGraw-Hill Education India, New Delhi.
2. Engineering Metrology, Jain R K, Khanna Publishers, New Delhi.

**REFERENCEBOOKS**

1. Industrial Organization and Engineering, Banga T.R. and Sharam S C, 2004, Khanna Publishers, New Delhi.
2. Mechanisms and Machine Theory, Rao J.S. and Dukkipatti R.V., 1990, Wiley Astern Ltd, New Delhi.
3. Theory of Mechanisms and Machines, Jagdish Lal, 191, Metropolitan Book Co. Pvt. Ltd, New Delhi.

**Course Outcome**

At the end of the course, student will be able to

CO1: Choose appropriate cutting tool material for a given application

CO2: Explain CNC tooling

CO3: Calculate limits, fits and tolerances

CO4: Apply the relevant motion control system of CNC machine for a given application

CO5: Develop part programme for a given product



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<b>III Year - II Semester</b>	<b>DAIRY AND FOOD ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**Objective:** The student knowledge on milk processing and unit operations in dairy processing including offer strength to students to handle pasteurization, sterilization, packaging, etc. of dairy products and control spoilage through process operations such as evaporation, freezing, membrane processing, etc.

### **UNIT-I**

Dairy development in India - Indian dairy industry. Products concentrated whole milk products – Composition, physico-chemical properties of milk, water content, acidity, pH, developed acidity, natural acidity, total acidity, density, specific gravity, freezing point colour and flavor of milk. Unit operations of various dairy and food processing systems - Centrifugation, separation, separation by cyclone (application of separation in the dairy industry, velocity of particles in a gravitational field, distribution of fat globule diameters in milk, velocity of particles in a centrifugal field, strength of centrifugal bowl, disc bowl centrifuge, design of centrifuges and methods of application, decanting centrifuge for lactose and casein, cyclones for separation from gas phase).

### **UNIT-II**

Milk receiving – Quantity determination, quality evaluation, clearing and disinfection of transport facilities, milk returns, procedures for reception and returns. Process flow charts for product manufacture – Pasteurized milk, process steps, person method and mass balance method for making balance of cream and fat in making whole milk, butter, cheese, ice cream manufacture, process steps, over run. Pasteurization - Purpose, microorganisms and enzymes and their reaction to temperature and other influences, bacteria in milk, effect of temperature. Pasteurization –Methods of heating, design and mode of operation heating equipment (vat, tubular heat exchanger, plate heat exchanger). Sterilization - UHT method (direct and indirect heating), sterilization in the package (temperature and pressure patterns), equipment for sterilizing goods in the package (batch autoclaves, continuously operating sterilizers). Freezing – Introduction, freezing point curve for food and water, freezing points of common food materials, freezing time calculation by using Plank's equation, types of freezing equipment types of equipment of leaching. Filtration – Ultra-filtration, processing variables, applications or ultra-filtration in milk processing. Reverse osmosis. Membrane separation – Membrane separation methods, gel filtration and ion exchange. Thermal processing.

### **UNIT-III**

Homogenization – Emulsifying, types of emulsions, emulsifiers, homogenizing (application, mode of operation, technical execution, effect of the product). Filling and packaging – Packaging of milk, cultured milk, cheese, butter, concentrated milk, products, dried milk products and packaging materials, filling and metering, packaging methods. Butter manufacture – Principle, treatment of cream, churning, overrun, factors affecting churn



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ability, methods (butter churn, continuous butter making), butter oil and special butter products (composition, methods of manufacturing, direct evaporation method, decantation, centrifugal separation, vacuum method). Thermal death time curve, reaction kinetics of the heat treatment of milk and its use for the assessment of UHT treatment methods, change in milk produced by heating, Plant utilities requirement – Electricity, water, power. Dairy plant design and layout – Factors in planning, importance of site selection, location of building, size and type of dairy building, advantages of good plant layout, functional design, operating schedule and layout, process selection, floor space, walls and ceiling ventilation, doors, windows, lighting, flooring and drainage.

#### **UNIT-IV**

Composition and proximate analysis of food products - Carbohydrates, protein, lipids, minerals, vitamins. Deterioration in products and their controls – Food as a substitute to microorganisms, food preservation methods, principles of food preservation, causes of food spoilage and classification of food with respect to spoilage and consumption. Principles of food preservation, effects of pH and water content on growth of microorganisms, methods of controlling water content, effect of water activity, methods of measuring a oxidation-reduction potential effect on microorganisms, effect of nutrient content and effect of inhibitory substances, biological structures, physical, chemical, and biological methods of food preservation. Change undergone by food components during processing – Changes during heating, evaporation, drying, freezing, juice extraction, filtration and separation.

#### **UNIT-V**

Evaporation – Applications, functions, factors affecting rate of evaporation, basic evaporator construction, factors affecting liquid boiling point, thermodynamics of evaporation (phase change, boiling point elevation, Duhring plot, factor influencing the overall heat transfer coefficient, influence of feed liquor properties on evaporation, factors influencing the economy of evaporation, types of evaporation equipment. Natural circulation evaporators – Batch type, horizontal short-tube, vertical short tube, natural circulation with external calendria, long tube, forced circulation (general forced circulation, plate, expanding flow, mechanical/agitated thin film). Drying – Drying methods (radiation, dielectric, spray, foam, spray, roller, fluidized bed, freeze).

#### **TEXTBOOKS**

1. Food Engineering and Dairy Technology, Kessler H G 1981. Verlag A. Kessler, Freising.
2. Outlines of Dairy Technology, Sukumar De 2005. Oxford University Press, New Delhi

#### **REFERENCE BOOKS**

1. Principles of Food Science, Fennema O R 2006. Marcel Dekkar Inc., New York.
2. Food Science, Chemistry and Experimental Foods, Swaminathan M, 2006. The Bangalore Printing & Publishing Co., Ltd, Bangalore



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**Course Outcome**

At the end of the course, student will be able to

- CO1: Estimate the physical and chemical properties of milk, water content, acidity, pH, developed acidity
- CO2: Analyze the parameters that influence pasteurization
- CO3: Describe emulsification and types of emulsions
- CO4: Estimate the carbohydrates, protein, lipids, minerals, vitamins in food product
- CO5: Analyze the factors influencing rate of evaporation, thermodynamics of evaporation, circulation in evaporators



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**R23 AGRICULTURAL ENGINEERING COURSE STRUCTURE & SYLLABUS**

<b>III Year - II Semester</b>	<b>PRINCIPLES OF DATABASE MANAGEMENT SYSTEMS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course Objectives:**

The main objectives of the course is to

- Introduce database management systems and to give a good formal foundation on the relational model of data
- Introduce the concepts of SQL
- Demonstrate the principles behind systematic database design approaches by covering conceptual design, logical design through normalization
- Provide an overview of physical design of a database system, by discussing database storage techniques

**UNIT I:**

Introduction: Database system, Characteristics (Database Vs File System), Database Users, Advantages of Database systems, Database applications. Brief introduction of different Data Models; Concepts of Schema, Instance and data independence; Three tier schema architecture for data independence; Database system structure, environment, Centralized and Client Server architecture for the database.

**UNIT II:**

Entity Relationship Model: Introduction, Representation of entities, attributes, entity set, relationship, relationship set, constraints, sub classes, super class, inheritance, specialization, generalization using ER Diagrams.

Relational Model: Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values, constraints (Domain, Key constraints, integrity constraints) and their importance.

**UNIT III:**

BASIC SQL: Simple Database schema, data types, table definitions (create, alter), different DML operations (insert, delete, update).

SQL: Basic SQL querying (select and project) using where clause, arithmetic & logical operations, SQL functions(Date and Time, Numeric, String conversion).Creating tables with relationship, implementation of key and integrity constraints, nested queries, sub queries, grouping, aggregation, ordering, implementation of different types of joins, view(updateable and non-updateable), relational set operations.

**UNIT IV:**

Schema Refinement (Normalization): Purpose of Normalization or schema refinement, concept of functional dependency, normal forms based on functional dependency Lossless join and dependency preserving decomposition, (1NF, 2NF and 3 NF), concept of surrogate key, Boyce-Codd normal form (BCNF).

**UNIT V:**

Transaction Concept: Transaction State, ACID properties, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Testing for Serializability, lock



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based, time stamp based, optimistic, concurrency protocols, Deadlocks, Failure Classification, Storage, Recovery and Atomicity, Recovery algorithm.

**Text Books:**

- 1) Database Management Systems, 3<sup>rd</sup> edition, Raghurama Krishnan, Johannes Gehrke, TMH (For Chapters 2, 3, 4)
- 2) Database System Concepts, 5<sup>th</sup> edition, Silberschatz, Korth, Sudarsan, TMH (For Chapter 1 and Chapter 5)

**Reference Books:**

- 1) Introduction to Database Systems, 8<sup>th</sup> edition, C J Date, Pearson.
- 2) Database Management System, 6<sup>th</sup> edition, Ramez Elmasri, Shamkant B. Navathe, Pearson
- 3) Database Principles Fundamentals of Design Implementation and Management, 10<sup>th</sup> edition, Corlos Coronel, Steven Morris, Peter Robb, Cengage Learning, 2022

**Web-Resources:**

- 1) <https://nptel.ac.in/courses/106/105/106105175/>
- 2) [https://infyspringboard.onwingspan.com/web/en/app/toc/lex\\_auth\\_01275806667282022456\\_shared/overview](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01275806667282022456_shared/overview)



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<b>III Year - II Semester</b>	<b>FARM MACHINERY AND EQUIPMENT - II LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**Objective:** To enable the student to get the practical knowledge on various operation in agricultural field for crop production.

### Practical

1. Introduction to different systems of CI engines
2. Engine parts and functions, working principles etc.
3. Valve system – study, construction and adjustments
4. Oil & Fuel – determination of physical properties
5. Air cleaning system; Fuel supply system of SI engine
6. Diesel injection system & timing;
7. Cooling system, and fan performance, thermostat and radiator performance evaluation
8. Part load efficiencies and governing
9. Lubricating system and adjustments
10. Starting and electrical system; Ignition system
11. Tractor engine heat balance and engine performance curves
12. Visit to engine manufacturer/ assembler/ spare parts agency

### TEXTBOOKS

1. Principles of Farm Machinery. Kepner R.A., Bainer, R and Barger E.L., 1987. CBS Publishers and Distributors, Delhi.
2. Elements of Agricultural Engineering. Jagadeshwar Sahay. 1992. Agro Book Agency, Patna.

### REFERENCE BOOKS

1. Farm Machinery. Stone A A, 1958. John Wiley and Sons. New York.
2. Farm Machinery and Equipment. Smith H P, 1971. Tata Mc Graw-Hills. Publishing Co. Ltd, New Delhi.
3. Principals of Agricultural Engineering, Vol. I. Michael A M and Ohja T P 1985. Jain Brothers, New Delhi.
4. Land Reclamation Machinery. Borshahov Mansurov Sergecv 1988 Mir Publishers, Moscow.

### Course Outcome

1. Study various implements and functional element
2. Evaluate field efficiencies and fuel efficiencies
3. Evaluate performance of various agricultural implements and machines
4. Design and calibrate seed drills and matching mechanism



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<b>III Year - II Semester</b>	<b>POST-HARVEST ENGINEERING FOR CEREALS, PULSES AND OILSEEDS LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**Objective:** To enable the students to acquire knowledge and skills on cleaning and grading, aspiration, scalping, size separators, screens, sieve analysis, capacity and effectiveness of screens, drying, different methods of drying, batch-continuous; mixing, non-mixing, sun, mechanical, conduction, convection, radiation, superheated steam, tempering during drying.

**Practical**

1. Performance evaluation of different types of cleaners and separators
2. Determination of separation efficiency
3. Study of different size reduction machines and performance evaluation
4. Determination of fineness modulus and uniformity index
5. Study of different types of conveying and elevating equipment
6. Study of different types of mixers
7. Measurement of moisture content: dry basis and wet basis
8. Study on drying characteristics of grains and determination of drying constant
9. Determination of EMC (Static and dynamic method)
10. Study of various types of dryers
11. Study of different equipment in rice mills and their performance evaluation
12. Study of different equipment in pulse mills and their performance evaluation
13. Study of different equipment in oil mills and their performance evaluation,
14. Type of process flow charts with examples relating to processing of cereals pulses and oilseeds
15. Visit to grain processing industries.

**TEXTBOOKS**

1. Chakraverty A Post Harvest Technology of cereals, pulses and oilseeds. Oxford & IBH Publishing Co. Ltd., New Delhi.
2. Dash, S.K., Bebartta, J.P. and Kar, A. Rice Processing and Allied Operations. KalyaniPublishers, New Delhi.

**REFERENCE BOOKS**

1. Earle R L, 2003. Unit Operations in Food Processing. Pergamon Press. Oxford. U.K.
2. Henderson S M, and Perry R L, Agricultural Process Engineering, Chapman and Hall, London
3. McCabe W L, Smith J C and Harriott P, Unit Operations of Chemical Engineering. McGraw-Hill.
4. Singh R Paul and Heldman R Dennis. 2004. Introduction to Food Engineering. 3rd Edition, Academic Press, London.



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<b>III Year - II Semester</b>	<b>COMPUTATIONAL FLUID DYNAMICS WITH FLUENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>1</b>	<b>2</b>	<b>2</b>

**Objective:**

1. To explain elementary details and numerical techniques for solving various engineering problems involving fluid flow
2. To study about finite difference applications in heat conduction and convection
3. To use finite difference for flow modeling
4. To understand the concepts of finite volume method
5. To understand the concepts of finite element method applied to heat transfer problems

**UNIT-I**

Review of equations governing fluid flow and heat transfer - Introduction, conservation of mass, Newton's second law of motion, expanded forms of Navier-Stokes equations (Derivation), conservation of energy principle, and special forms of the Navier-Stokes equations.

Applied numerical methods. Solution of a system of simultaneous linear algebraic equations, iterative schemes of matrix inversion, direct methods for matrix inversion, direct methods for banded matrices, TDMA – Algorithms.

**UNIT-II**

Finite difference applications - Steady flow, dimensionless form of momentum and energy equations, stokes equation, conservative body force fields, stream function, vorticity formulation. Finite difference applications in heat conduction and convection – Heat conduction, steady heat conduction in a rectangular geometry, transient heat conduction, finite difference application in convective heat transfer, closure.

**UNIT-III**

Finite difference for flow modeling - Discretization, consistency, stability and fundamentals of fluid flow modelling: introduction, elementary finite difference quotients, implementation aspects of finite-difference equations, consistency, explicit and implicit methods.

**UNIT-IV**

Fluid flow modeling - Introduction to first order wave equation, stability of hyperbolic and elliptic equations, fundamentals of fluid flow modelling, conservative property, the upwind scheme. Finite volume method - Approximation of surface integrals, volume integrals, interpolation and differentiation practices, upwind interpolation, linear interpolation and quadratic interpolation.



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**UNIT-V**

Finite element methods – Introduction, weighted residual and variational formulations, Rayleigh-Ritz method, interpolation, One-dimensional and two-dimensional regions, Error control, applications of FEM to one dimensional problems (steady and transient), two dimensional problems.

**TEXTBOOKS**

1. Numerical Heat Transfer and Fluid Flow, Suhas V Patankar, Butter-Worth Publishers
2. Computational Fluid Dynamics - Basics with Applications, John D Anderson, McGraw-Hill.

**REFERENCE BOOKS**

1. Computational Fluid Flow and Heat Transfer, Niyogi, Pearson Publications
2. Introduction to CFD: Finite Volume Method, H Versteeg and W Malalasekara
3. Fundamentals of Computational Fluid Dynamics, Tapan K Sengupta, Universities Press.
4. Computational Fluid Dynamics: An Introduction, 3<sup>rd</sup> Edition, John F Wendt, Springer publishers

**Course Outcome**

At the end of the course, student will be able to

CO1: Explain elementary details and numerical techniques for solving various engineering problems involving fluid flow

CO2: Study about finite difference applications in heat conduction and convection

CO3: Apply finite difference for flow modeling

CO4: Understand the concepts of finite volume method

CO5: Understand the concepts of finite element method applied to heat transfer problems



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## COURSE STRUCTURE

### IV Year – I Semester

S. No.	Category	Subject	L	T	P	Credits
1	PC	Soil and Water Conservation Engineering	3	0	0	3
2	PC	Instrumentation and Process Control in Food Industry	3	0	0	3
3	MC-II	Operations Research	2	0	0	2
4	PE-IV	1. Design of Soil and Water Conservation and Farm Systems 2. Food Process Equipment Design 3. Design of Agricultural Machinery	3	0	0	3
5	PE-V	1. Micro Irrigation Engineering 2. Mechatronics in Agricultural Engineering 3. Food Plant Design and Management	3	0	0	3
6	OE-IV	1. Electronics Engineering Department (e.g. Sensors and Electronic Controls Engineering) 2. Quantum Science and Technology	3	0	0	3
7	PC	Theory of Machines Lab	0	0	3	1.5
8	PC	Instrumentation Engineering Lab	0	0	3	1.5
9	SEC	Agricultural Machinery Design using CAD/CAM	0	1	2	2
10	AC	Constitution of India	2	0	0	-
11		Evaluation of Industry Internship	-	-	-	2
		<b>Total</b>	<b>19</b>	<b>1</b>	<b>6</b>	<b>23</b>
		<b>Honors (Pool-4)/Minor Courses</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

### IV Year – II Semester

S. No.	Category	Subject	L	T	P	Credits
1	PR	Internship and Project Work	0	0	24	12
		<b>Total</b>	<b>0</b>	<b>0</b>	<b>24</b>	<b>12</b>



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<b>IV Year I Semester</b>	<b>SOIL AND WATER CONSERVATION ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Objective:** To enable the students to acquire knowledge on different soil loss estimation models, runoff estimation by rational, curve number, cook's, etc. Land use capability classification, soil conservation measures like contour bunding, terracing, bench terraces, contour trenches and their types and complete design calculations. Also, to enrich and familiarize the students in the design of various gully control structures, temporary and permanent, their designs with a due importance to hydrologic, hydraulic and structural phases of design.

#### **UNIT-I**

Runoff – Factors affecting runoff – Peak runoff and design of peak runoff – its estimation - Rational method – Time of concentration and its estimation – Curve number method – Cook's method. Land use capability classification based on different criteria with a special reference to slope.

#### **UNIT-II:**

Introduction – Soil and water conservation research in India–Its sub-centers–Soil erosion– Geologic, Types and erosion procedures, Accelerated types. Causes and agents of erosion – Factors affecting erosion – Water erosion–Forms of water erosion – Mechanics of erosion - Different stages of erosion – Rill – Sheet – Gully and ravines—Gully erosion, its classification, stages of gully development. Soil loss estimation–Universal soil loss equation and modified soil loss equation, Explanation of various terms – Estimation of their various parameters. Erosion control measures – Agronomic and mechanical or engineering measures.

#### **UNIT-III:**

Wind Erosion – Factors affecting wind erosion, mechanics of wind erosion, Wind erosion control measures – Vegetative, mechanical measures, wind blades and shelter belts, sand dunes stabilization – Wind erosion and its control.

#### **UNIT-IV:**

Contour bunds – Design of contour bunds – Horizontal interval – Vertical interval – Cross section of the contour bunds – Seepage line consideration. Determination height of bund – Loss of area due to bunding. Design of waste weir – Construction of contour bunds in fields. Graded bunds – Design of graded bunds. Introduction to conservation ditching. Contour trenching – Staggered and continuous trenches – Adaptability and types. Terraces – Classification of terraces - Design of narrow based and broad-based terraces. Bench terraces – Types of bench terraces – Derivation of an equation for finding of vertical interval – Design of bench terraces.

**UNIT-V:** Vegetated water ways – Types of water ways based on shapes – Expression for wetted perimeter – C/S areas – Hydraulic radii – types of vegetation – roughness of different grasses –





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<b>IV Year I Semester</b>	<b>INSTRUMENTATION AND PROCESS CONTROL IN FOOD INDUSTRY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Objectives:** To enable the students to understand concept of characteristics of instruments, Temperature and temperature scales, Liquid level measurement, Measurement of moisture content, pneumatic and electrical control systems; Various process controls and different controllers and indicators.

#### **UNIT-I**

Introduction, definitions, characteristics of instruments, static and dynamic characteristics; Temperature and temperature scales; Various types of thermometers; thermocouples, resistance thermometers and pyrometers; Pressure and pressure scales, manometers, pressure elements differential pressure.

#### **UNIT-II**

Liquid level measurement, different methods of liquid level measurement; Flow measurement: Kinds of flow, rate of flow, total flow differential pressure meters, variable area meters, food flow metering; Weight measurement: Mechanical scale, electronic tank scale, conveyor scale.

#### **UNIT-III**

Measurement of moisture content, specific gravity, measurement of humidity, measurement of viscosity, turbidity, color, measurement of density, brix, pH, enzyme sensors, automatic valves; Transmission: Pneumatic and electrical; Control elements, control actions, pneumatic and electrical control systems.

#### **UNIT-IV**

Process control: Definition, simple system analysis, dynamic behaviour of simple process, Laplace transform, process control hardware; Frequency response analysis, frequency response characteristics, Bode diagram and Nyquist plots and stability analysis; Transducers: Classification, self-generating transducers, variable parameter type, digital, actuating and controlling devices;

#### **UNIT-V**

Controllers and indicators: Temperature control, electronic controllers, flow ratio control, atmosphere control, timers and indicators, food sorting and grading control, discrete controllers, adaptive and intelligent controllers; Computer-based monitoring and control: Importance, hardware features of data acquisition and control computer, signal interfacing, examples in food processing.



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**TEXTBOOKS**

1. Don W. Green and Robert H. Perry. 2008. Perry's Chemical Engineers' Handbook. McGraw-Hill Co., Inc., NY, USA.
2. Bela G. Liptak. 2003. Instrument Engineer's Handbook, Vol. I and II, 4th Ed. CRC Press, Boca Raton, FL, USA.

**REFERENCE BOOKS**

1. Curtis D. Johnson. 2003. Process Control Instrumentation Technology, 7th Ed. Prentice Hall of India Pvt. Ltd., New Delhi.
2. D.V.S. Murty. 2004. Transducers and Instrumentation. Prentice-Hall of India Pvt. Ltd. New Delhi.

**COURSE OUTCOMES**

At the end of the course, student will be able to

- CO1: Estimate Temperature and temperature scales
- CO2: Analyze the different methods of liquid level measurement
- CO3: Estimate the moisture content, specific gravity, measurement of humidity
- CO4: Discuss simple system analysis, dynamic behavior of simple process
- CO5: Apply Temperature control, electronic controllers, flow ratio control, atmosphere control



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<b>IV Year I Semester</b>	<b>OPERATIONS RESEARCH</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**Course Objectives:** Student will acquire the knowledge

- Introduce the fundamentals of operations research and linear programming techniques.
- Teach optimization in transportation, assignment, and sequencing problems.
- Explain models for replacement strategies and decision-making using game theory.
- Provide knowledge on queuing models and inventory control techniques.
- Introduce dynamic programming principles and simulation modeling.

### **UNIT-I**

**INTRODUCTION** - definition– characteristics and phases – types of operation research models – applications.

**LINEAR PROGRAMMING:** Linear programming problem formulation – graphical solution – simplex method – artificial variables techniques -two–phase method, big-M method – duality principle.

### **UNIT-II**

**TRANSPORTATION PROBLEM:** Formulation – optimal solution, unbalanced transportation problem – degeneracy, assignment problem – formulation – optimal solution - variants of assignment problem- travelling salesman problem.

**SEQUENCING** – Introduction – flow –shop sequencing – n jobs through two machines – n jobs through three machines – job shop sequencing – two jobs through ‘m’ machines.

### **UNIT-III**

**REPLACEMENT:** Introduction – replacement of items that deteriorate with time – when money value is not counted and counted – replacement of items that fail completely, group replacement.

**THEORY OF GAMES:** Introduction – mini. max (max. mini) – criterion and optimal strategy – solution of games with saddle points – rectangular games without saddle points – 2 x 2 games – dominance principle – m x 2 & 2 x n games -graphical method.

### **UNIT-IV**

**QUEUEING THEORY:** Introduction – single channel – poisson arrivals – exponential service times – with infinite population and finite population models– multichannel – poisson arrivals – exponential service times with infinite population single channel.

**INVENTORY CONTROL:** Introduction – single item – deterministic models – purchase inventory models with one price break and multiple price breaks – shortages are not allowed – stochastic models – demand may be discrete variable or continuous variable, Instantaneous demand and continuous demand and no set up cost. ABC & VED Analysis.





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<b>IV Year - I Semester</b>	<b>DESIGN OF SOIL AND WATER CONSERVATION AND FARM SYSTEMS (Professional Elective - IV)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Objective:** To enable the students to design and execute the structures for controlling soil erosion due to water, irrigation in fields and prepare cost estimates for the structures.

#### **UNIT-I**

Flow in open channels – types of flow, state of flow, regimes of flow, energy and momentum – principles, specific energy and specific force – critical depth concept–stage discharge relationship–sequent depths. Hydraulic jump and its application, type of hydraulic jump, energy dissipation due to jump, jump efficiency, relative loss of energy – Froude number and its significance in the design of hydraulic structures.

#### **UNIT-II**

Runoff measuring structures – Parshall flume, H-Flume and weirs, water stage recorders, straight drop spill way-general description, functional use, advantages and disadvantages, structural parts and functions, components of spillway. Three design phases – hydrologic and hydraulic design, free board and wave free board, aeration of weirs, concept of free and submerged flow. Structural design of a drop spillway–loads on headwall, variables affecting equivalent fluid pressure. Determination of saturation line for different flow conditions, seepage under the structure, equivalent fluid pressure of triangular load diagram for various flow conditions. Creep line theory, uplift pressure estimation, safety against sliding, overturning, crushing and tension.

#### **UNIT-III**

Chute spillway- general description and its components, hydraulic design, energy dissipaters – uplift pressure diagram – analysis of various forces etc. Design criteria of a SAF stilling basin and its limitations. Drop inlet spillway – general description, types of possible flow conditions, pipe flow, orifice flow, functional use, design criteria. Irrigation Engineering structures – Various types and their purposes. Differences between soil conservation and irrigation structures.

#### **UNIT-IV**

Canal falls – Types of canal falls with line diagrams (elevations). Design of trapezoidal notch fall. Design of syphon well drop type of canal falls. Cross drainage works – locations needing cross drainage works – aqueduct – super passage – inverted siphon aqueduct – inlets and outlets – different types of cross drainage works with line diagrams. Design principles of various cross drainage works – design of an aqueduct.

#### **UNIT-V**

Irrigation outlets – non modular, semi modular rigid modular outlets battle sluice irrigation modules. Diversion head works – Different components of diversions head works – head regulator and cross regulator. Different types of weirs and barrages – Difference between a weir and barrage with example locations. Operation of gates in controlling water in irrigation structures.



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**TEXTBOOKS**

1. Soil and Water Conservation Engineering. Schwab G.O., Frevert R.K. Edminister T.W. and Barnes K.K. 1981. John Wiley and Sons, New York.
2. Irrigation Engineering and Hydraulic Structures. Garg S.K. 1986. Khanna Publications. New Delhi.

**REFERENCES BOOKS**

1. Irrigation Engineering. Mazumdar. S.K. 1983. TMH Publishing Co. Ltd., New Delhi.
2. Irrigation Water Resources. Modi P.N. 1990. Standard Book House. Post Box No. 1074. New Delhi.
3. Hydrology and Soil Conservation Engineering. Ghanshyam Das 2009 PHI Learning Private Limited, New Delhi

**COURSE OUTCOMES**

At the end of the course, student will be able to

- CO1: Analyze types of flow, state of flow, regimes of flow.
- CO2: Estimate runoff by using Parshall flume, H-Flume and weirs, water stage recorders, straight drop spill way-general description.
- CO3: Design Chute spillway and SAF stilling basic
- CO4: Design trapezoidal notch fall and syphon well drop type of canal falls.
- CO5: Analyze different components of diversions head works.



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<b>IV Year - I Semester</b>	<b>FOOD PROCESS EQUIPMENT DESIGN</b> <b>(Professional Elective - IV)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Objectives:** To evaluate students to understand the general procedure of designing different food processing equipment and optimizing the design with respect to process efficiency, energy and cost.

#### **UNIT-I**

Introduction on process equipment design - factors influencing the design of vessels criteria in vessel design – application of design engineering for processing equipment, design parameters and general design procedure.

#### **UNIT-II**

Material specification – types of material for process equipment, design procedure, material specification, types of material for process equipment design of shells and roofs – proportioning, head selection, supporters, pressure and stress considerations in different process equipment – Design codes: design of different food process equipment to code specifications.

#### **UNIT-III**

Design of different food processing equipment – pressure vessel design, design of vessels with closures operating under extended pressure, design pressure vessels to code specifications, design of high pressure monobolic and multilayer vessels, cleaners, tubular heat exchanger, shell and tube heat exchanger and plate heat exchanger.

#### **UNIT-IV**

Design of belt conveyer, screw conveyer and bucket elevator – Design of dryers – fluidized bed, rotary, rolling bed, conduction convection, spray and freeze dryers. Design of milling equipment – pulverizers, flour mills – hand operated and mechanical mills – disc mills, rotary mills, dry and wet mills.

#### **UNIT-V**

Optimization design of food process equipment – factors to be considered in optimization of design of different food processing equipment – process efficiency, energy utilization, cost – computer aided design.

#### **TEXT BOOKS**

1. Geankoplis C.J. 2003. Transport Processes and Unit Operations, Prentice-Hall, New York.
2. Bhattacharyya, B.C.2008. Introduction to Chemical Equipment Design, CBS Publishers and Distributors, New Delhi.





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**R23 AGRICULTURAL ENGINEERING COURSE STRUCTURE AND SYLLABUS**

<b>IV Year - I Semester</b>	<b>DESIGN OF AGRICULTURAL MACHINERY</b> <b>(Professional Elective - IV)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Objective:** To enable the students to understand the general procedure for designing any machine parts. To know the design of cotter and knuckle joints, leavers, springs, various types of shafts, couplings bearings and various IC engine parts.

### **UNIT-I**

Machine Design – Definition, Classification of machine design, General considerations in machine design, General procedure in machine design. Fundamental units, Mass and Weight, inertia, laws of motion, force, moment of force, couple mass density, torque, work, power and energy. Simple stress in machine parts – Introduction, load, stress, strain, tensile stress and strain, compressive stress and strain, Young’s modulus, shear stress and strain, shear modulus, bearing stress.

### **UNIT-II**

Stress strain diagram, working stress, Factor of safety and selection, stresses in composite bars, thermal stress, linear and lateral strain, Poisson’s ratio, volumetric strain, bulk modulus and relations, impact stress, resilience. Principal stresses and principal planes – Theories of failure under static load, Rankine’s theory, Guest’s theory, maximum distortion theory, stress concentration, notch sensitivity - Important terms used in Limit System, fits, types of cotter joints, design of socket and spigot cotter joint. Knuckle joint, Dimensions of various parts of knuckles joint, methods of failure of knuckle joint, design procedure of knuckle joint.

### **UNIT-III**

Levers – Introduction, application of levers in engineering practice, design of lever hand levers, foot lever, cranked lever. Springs – Introduction, types of springs, material for helical springs, spring wire, terminology, springs in series and parallel, flat spiral springs, leaf springs, construction of leaf springs.

### **UNIT-IV**

Shafts – Material used for shafts, types and sizes of shafts, stresses in shafts, maximum working stresses. Design of shafts, for twisting moment, bending moments, fluctuating loads, axial load in addition to combined twisting and bending loads, design of shafts on the basis of rigidity. Keys and coupling – Introduction, types of keys, sunk keys, saddle keys, tangent keys, round keys, splines, forces acting on sunk keys, strength of sunk key. Effect of key ways, shaft couplings, types of shaft couplings, muff coupling, design of flange coupling.

### **UNIT-V**

Design of Machinery: Design of Tillage equipment –a. Cultivator (Manually Drawn and Power Operated); b. Rotavator (Power Operated); c. M.B Plough (Manually Drawn and Power Operated)





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<b>IV Year - I Semester</b>	<b>MICRO IRRIGATION ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>(Professional Elective - V)</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Objective:** To impart knowledge and skills to students to design micro irrigation systems to improve water productivity of different crops and to perform economic analysis and to prepare project proposals and cost estimates of micro – irrigation Systems.

### **UNIT-I**

Sprinkler Irrigation, Historical development, Scenario in the world, country and state, adoptability and limitations, Components of the sprinkler system, pump set (Centrifugal, turbines and Submersible), Main lines, Lateral lines, Sprinkler heads, Debris screens, Desalting basins, booster pumps, Take-off valves, Flow control valves (individual sprinkler).

### **UNIT-II**

Types of sprinkler Irrigation systems: A. Based on mechanism: i) Rotating head system, ii) Perforated pipe system, B. Based on portability: i) Portable systems, ii) Semi-portable systems, iii) Semi-permanent systems, iv) Permanent systems and v) Solid set systems. Precipitation profiles and Moisture distribution patterns, Recommended sprinkler spacings, Effects of wind speed on working of the system, Importance of distribution uniformity, Christiansen uniformity coefficient, Distribution uniformity. Suitability of crops under sprinkler irrigation.

### **UNIT-III**

Design of Sprinkler system, layout, laterals and mains: i) Inventory of Resources and Conditions, ii) Types of system and Layout, iii) Sprinkler Selection and Spacing, iv) Capacity of Sprinkler Systems, v) Hydraulic Design of Sprinkler Systems, vi) Selection of pump, Operation and maintenance of system, Field evaluation of the system, Cost analysis.

### **UNIT-IV**

Drip Irrigation, Historical development, Scenario in the World, Country and State, Advantages and Limitations, Components of drip irrigation: A. Head Control- Non return valve, Air release & Vacuum breaker, Filter, Fertigation Tank, Throttle valve, Pressure gauge, other fittings, venture type Fertilizer injection pumps. B. Wayer carrier systems- PVC pipeline, Control valve, Flush valve, other fittings, C. Water distribution systems- Drip lateral, Drippers, Emitting pie, Grommet, Start connector, Nipple, End cap, Micro tube, Barbed connector, Drip hydraulics, Pipe section, Water flow in pipes, Velocity recommended pressure, Press

### **UNIT-V**

Types of Emitters: A) Based on Floe regime (Reynolds number): i) Laminar Flow, ii) Partially turbulent flow, iii) Fully turbulent flow and B) Based on Lateral connection: i) in-line and ii) online, Emitter flow equation, Emitter constants, Pressure variations (%) for different emitter flow variations and x-values, Emission uniformity (EU), Distribution Uniformity and Irrigation efficiency. Planning and design of drip system- Collection of primary data, Layout, crop water



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requirements, hydraulic design, selection of components, Economic pipe size selection, Pressure variation Along drip Irrigation and design criteria of lateral, sub-main and mail lines, Pai-wu I design charts. Installation, operation and Maintenance of drip irrigation systems, testing and field evaluation of the system, Computer Software programs for design of drip irrigation systems, Automation of drip irrigation systems – i) Volume based, ii) time based and iii) Soil moisture bases systems.

### **TEXTBOOKS**

1. Drip Irrigation & Sprinkler Irrigation, Sivanappan R K Padma Kumari O and Kumar V 1997, Keerthi Publishing House Pvt. Ltd., Coimbatore.
2. Drip and Sprinkler Irrigation Systems. Nakayama and Prucks.

### **REFERENCE BOOKS**

1. Micro-Irrigation for Crop Production, Design, Operation and Management, Freddie R. Lamm, James E. Ayars and Francis S, Nakayama, 2006, Elsevier Publications, Singapore.
2. Land and Water Management Principles, R. Suresh, 2008, Standard Publishers Distributors, Delhi.

### **COURSE OUTCOMES**

At the end of the course, student will be able to

- CO1: Explain the concept of Sprinkler Irrigation and its components.
- CO2: Discuss Precipitation profiles and Moisture distribution patterns, sprinkler spacings.
- CO3: Design Sprinkler system, layout, laterals and mains.
- CO4: Describe drip Irrigation and its components.
- CO5: Plan for installation of drip irrigation system.



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**R23 AGRICULTURAL ENGINEERING COURSE STRUCTURE AND SYLLABUS**

<b>IV Year - I Semester</b>	<b>MECHATRONICS IN AGRICULTURAL ENGINEERING (Professional Elective - V)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Objective:** To impart knowledge and skills to students to understand the concept of mechatronics, measurement system, control systems, Signal conditioning process, Micro-processor and computer, Robotics, Robot components, robot classification, Assembly operations, Inspection automation and Future applications.

### **UNIT-I**

Definition of mechatronics, measurement system, control systems, microprocessor-based controllers, mechatronics approach. Sensors and transducers, performance terminology, Displacement, Position and Proximity Sensors, photo-electric transducers, flow transducers, optical sensors and transducers.

### **UNIT-II**

Actuators, Mechanical Actuation Systems, Hydraulic and Pneumatic Actuation Systems, Electrical Actuation Systems, A.C. Motor, D.C. Motor, Stepper Motor.

### **UNIT-III**

Signal conditioning process, filtering digital signal, multiplexers, data acquisition, digital signal processing, measurement system, pulse modulation, data presentation systems. System modelling and control, Mathematical models, Engineering systems, Electro-mechanical and Hydraulic-mechanical Systems, Modelling Dynamic Systems, Transfer Functions, Control Modes, PID Controller.

### **UNIT-IV**

Micro-processor and computer, Computer and Interfacing, Micro-computer Structure, Micro-controllers, Application of Microcontrollers, PLC.

### **UNIT-V**

Robotics, Robot components, robot classification and specification, Work envelopes, other basic parameters of robots. Robot applications, Robot applications in manufacturing, Material transfer and machine loading/unloading, Processing operations like welding and painting, Assembly operations, Inspection automation, Future applications.

### **TEXTBOOKS**

1. Bolton, W. Mechatronics. Pearson Education Asia.
2. Wolfram, Stadler. Analytical Robotics and Mechatronics. Mc-Graw Hill.
3. Doebelin E.O. Measurement Systems. Mc-Graw Hill.



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**REFERENCE BOOKS**

1. Mahind, A.P. Introduction to Digital Computer Electronics. TMH.
2. Niku, S.Y. Introduction to Robotics: Analysis, systems and applications”, Pearson Education Asia.
3. Craig, J.J. Introduction to Robotics. Pearson Education Asia.

**COURSE OUTCOMES**

At the end of the course, student will be able to

- CO1: Describe various mechatronics systems, measurement systems, sensors and transducers.
- CO2: Explain the functionality of solid-state electronic devices.
- CO3: Identify the components in the design of electro mechanical systems.
- CO4: Apply the concepts of digital electronics and applications of PLCs for control.
- CO5: Analyze the system interfacing, data acquisition and design of mechatronics systems



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<b>IV Year - II Semester</b>	<b>FOOD PLANT DESIGN AND MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>(Professional Elective - V)</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Objective:** Students will be trained in organization of food and agricultural processing plant machinery as per process flow, site selection, layout procedures, project design concepts, etc. will be explained for bringing the talent to establish an engineering industry.

### **UNIT-I**

Plant layout – Definition, and principles, factors in planning layouts. Methods of layout planning – Unit areas concept, two – dimensional layouts, scale models. Principles of plant layout – Storage layout, equipment layout, safety, plant expansion, floor space, utilities servicing, building, materials handling equipment, rail roads and roads.

### **UNIT-II**

Types of plant layout – salient features of horticultural, rice, maize, pulses, oil seeds, poultry, fish, meat, milk and milk product plants.

### **UNIT-III**

Location selection criteria – Plant location, factors in selecting a plant, selection of the plant site, preparation of the layout. Selection of processes – Comparison of different processes, batch versus continuous operation. Plant capacity – Equipment design and specifications, scale-up in design, safety factors, specifications, materials of construction. Project design – Process design development, general overall design considerations, cost estimation, factors affecting profitability of investments, optimum design (economic and operation). Project design – Practical considerations in design, approach. Project design – Types of designs, feasibility survey, process development, design, construction and operation, design information from the literature.

### **UNIT-IV**

Flow diagrams-qualitative and quantitative flow diagrams. Selection of equipment – Preliminary design, problem statement, literature survey, material and energy balance, equipment design and selection, problems, economics. Process and controls-Control systems, instrumentation control, maintenance, computer aided design. Handling equipment - Selection, factors, pumps, piping, fittings, solid feeders, plant layout. Plant elevation - Requirement of plant building and its components, foundation for equipment and dynamic loading, flooring, walls, roof, illumination, air-conditioning. Labor requirement for processing plant - Labor costs, maintenance.

### **UNIT-V**

Food plant sanitation-Environmental protection, regulations, pollution control, air pollution abatement, particulate removal, noxious gas removal, thermal pollution control, recycling, CIP. Cost analysis cost indexes - Cash flow for industrial operations, factors affecting investment and



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production costs, capital investment, and estimation of capital investment. Cost analysis – Cost indexes, cost factors in capital investment, estimation of total product cost. Preparation of

feasibility report -Types of reports, organization of reports, organization of a design report, preparing the report, rhetoric, checklist for the final report.

### **TEXTBOOKS**

1. Dairy and Food Engineering, Farall F W 1992. John Wiley & Sons, New York.
2. Food Technology Processing and Aylward F 2001. Allied Scientific Publishers, Bikaner. Laboratory Control.

### **REFERENCE BOOKS**

1. Plant Layout and Design, James M Moor, Macmillan, New York.
2. Milk Plant Layout, Hall H S and Y. Rosen, FAO publications, Rome.
3. Principles of Food Sanitation, Marriott N G 1985. Van Nostrand Reinhold Company, New York.

### **COURSE OUTCOMES**

At the end of the course, student will be able to

- CO1: Explain the principles of plant layout.
- CO2: Select a suitable plant layout for a given product.
- CO3: Use principal considerations for plant location and design of layout
- CO4: Describe the design criteria of plant building
- CO5: Estimate Cost indices, total product cost.



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IV Year I Semester	<b>QUANTUM SCIENCE AND TECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Prerequisites:** Basic Physics, Linear Algebra, and Introduction to Modern Physics

**Course Objectives:**

1. To introduce fundamental concepts of quantum mechanics and its mathematical formalism.
2. To explore quantum computing and communication principles and technologies.
3. To understand the physical implementation and limitations of quantum systems.
4. To enable students to relate quantum theory to practical applications in computing, cryptography, and sensing.
5. To familiarize students with the emerging trends in quantum technologies.

**Course Outcomes:**

After completing this course, students will be able to:

- CO1. Explain core principles of quantum mechanics and their technological implications.  
CO2. Analyze quantum phenomena like superposition and entanglement.  
CO3. Apply mathematical tools to model and solve quantum systems.  
CO4. Demonstrate understanding of quantum algorithms and quantum circuits.  
CO5. Evaluate potential applications and challenges in quantum communication and sensing.

**Unit 1: Fundamentals of Quantum Mechanics:** Historical background: Blackbody radiation, photoelectric effect, and Compton scattering; Dual nature of light and matter; De Broglie hypothesis; Schrödinger equation; Free particle, infinite potential well, step potential; Operators and observables: position, momentum, Hamiltonian; Commutation relations and uncertainty principle; Quantum postulates and measurement theory; Eigenvalues, eigenfunctions.

**Unit 2: Quantum Information Theory:** Classical vs. quantum information; Qubit representation using Bloch sphere; Quantum superposition and quantum entanglement; Dirac notation (bra-ket), tensor products, and composite systems; Bell states and EPR paradox; Quantum gates: Pauli-X, Y, Z; Hadamard; Phase; T; CNOT; Quantum circuit models and notation; Measurement in computational basis; Quantum teleportation and no-cloning theorem; Quantum state tomography (introductory)

**Unit 3: Quantum Computing:** Classical computing review and limitations; Quantum parallelism and interference; Deutsch and Deutsch-Jozsa algorithms; Grover's search algorithm, Oracle and amplitude amplification; Shor's factoring algorithm (overview and significance); Quantum Fourier Transform (QFT); Quantum error correction: Bit-flip, phase-flip, and Shor's 9-qubit code; Introduction to quantum programming: Qiskit, Cirq, IBM Quantum Experience (overview)



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**Unit 4: Quantum Communication:** Introduction to quantum cryptography; Quantum key distribution (QKD): BB84 protocol; Entanglement-based QKD: Ekert protocol (E91); Eavesdropping and security of QKD; Quantum teleportation (circuit and protocol); Quantum dense coding; Quantum networks and entanglement swapping; Role of quantum repeaters; Single-photon sources and detectors; Implementation challenges (loss, decoherence, noise)

**Unit 5: Quantum Technologies and Applications:** Quantum sensors: magnetometry, gravimetry; Quantum metrology: standard time, atomic clocks; Quantum imaging and lithography; Quantum materials: topological insulators, graphene, quantum dots; NV centers in diamonds for sensing; Hardware platforms: Superconducting qubits, Trapped ions, Photonic quantum processors; Quantum supremacy and NISQ era; Global initiatives: IBM, Google, D-Wave, IonQ, India's NQM; Ethical concerns and future prospects

**Text Books:**

1. "**Quantum Computation and Quantum Information**" by Michael A. Nielsen and Isaac L. Chuang
2. "**Quantum Mechanics: Concepts and Applications**" by Nouredine Zettili

**Online Learning Resources:**

1. <https://nptel.ac.in/courses/104104082>
2. <https://nptel.ac.in/courses/115104096>  
<https://nptel.ac.in/courses/122106034>







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<b>IV Year I Semester</b>	<b>AGRICULTURAL MACHINERY DESIGN USING CAD/CAM</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>1</b>	<b>2</b>	<b>2</b>

### LIST OF EXPERIMENTS

1. Application of computers for designing and Overview of CAD window – explanation of various options on drawing screen.
2. Study of draw tool bar and practice on draw tool bar.
3. Study on dimension and dimensional editing tool bar and Practice on dimension toolbar.
4. Study of OSNAP, and application OSNAP.
5. Study on layer command and modifying drafting.
6. Practice on mirror, offset and array commands.
7. Practice on trim, extend, chamfer and fillet commands.
8. Practice on copy, move, and scale and rotate commands.
9. Practice on rotate and trim commands.
10. Drawing of 2-D- orthographic projections using draw tool bar.
11. Drawing of 2-D- orthographic projections and dimensioning using draw tool bar.
12. Drawing of isometric projections.
13. Practice on creating boundary, region, hatch and gradient commands.
14. Practice on Editing polyline-PEDIT and Explode commands.
15. 2-D - Drawing of knuckle joint.
16. Drawing of hexagonal, nut and bolt.
17. Practice on 3-D commands- Extrusion and loft commands.
18. Practice on 3-D commands on sweep and press pull commands.
19. Practice on 3-D Commands- revolving and joining commands.
20. Demonstration on CNC machine and simple problems.

### TEXTBOOK

1. Rao P.N. 2002, CAD/CAM Principles and Applications. McGraw-Hill Education Pvt.Ltd., New Delhi.

### REFERENCE BOOK

1. Sareen Kuldeep and Chandan Deep Grewal. 2010, “CAD/CAM Theory and Practice”. S. Chand & Company Ltd., New Delhi.



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<b>IV Year - I Semester</b>	<b>CONSTITUTION OF INDIA</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>0</b>	<b>-</b>

**Course Objectives:** Student will acquire the knowledge

- To enable the student to understand the importance of constitution
- To understand the structure of executive, legislature and judiciary
- To understand philosophy of fundamental rights and duties
- To understand the autonomous nature of constitutional bodies like Supreme Court and high court controller and auditor general of India and election commission of India.
- To understand the central and state relation financial and administrative

### **UNIT-I**

Introduction to Indian Constitution: Constitution meaning of the term, Indian Constitution - Sources and constitutional history, Features - Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.

**Learning outcomes:**

After completion of this unit student will

- Understand the concept of Indian constitution
- Apply the knowledge on directive principle of state policy
- Analyze the History, features of Indian constitution
- Evaluate Preamble Fundamental Rights and Duties

### **UNIT-II**

Union Government and its Administration Structure of the Indian Union: Federalism, Centre-State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha, The Supreme Court and High Court: Powers and Functions;

**Learning outcomes:** After completion of this unit student will

- Understand the structure of Indian government
- Differentiate between the state and central government
- Explain the role of President and Prime Minister
- Know the Structure of supreme court and High court

### **UNIT-III**

State Government and its Administration Governor - Role and Position - CM and Council of ministers, State Secretariat: Organization, Structure and Functions.

**Learning outcomes:** After completion of this unit student will

- Understand the structure of state government
- Analyze the role Governor and Chief Minister
- Explain the role of state Secretariat
- Differentiate between structure and functions of state secretariat



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#### **UNIT-IV**

A. Local Administration - District's Administration Head - Role and Importance, Municipalities – Mayor and role of Elected Representative - CEO of Municipal Corporation PachayatiRaj: Functions PRI: Zila Panchayat, Elected officials and their roles, CEO Zilla Panchayat: Block level Organizational Hierarchy - (Different departments), Village level - Role of Elected and Appointed officials - Importance of grass root democracy.

**Learning outcomes:** After completion of this unit student will

- Understand the local Administration
- Compare and contrast district administration role and importance
- Analyze the role of Myer and elected representatives of Municipalities
- Evaluate Zilla Panchayat block level organization

#### **UNIT-V**

Election Commission: Election Commission- Role of Chief Election Commissioner and Election Commissionerate State Election Commission: Functions of Commissions for the welfare of SC/ST/OBC and women

**Learning outcomes:** - After completion of this unit student will

- Know the role of Election Commission apply knowledge
- Contrast and compare the role of Chief Election commissioner and Commissionerate
- Analyze role of state election commission
- Evaluate various commissions of viz SC/ST/OBC and women

#### **REFERENCE BOOKS**

- 1) Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall of India Pvt. Ltd, New Delhi
- 2) Subash Kashyap, Indian Constitution, National Book Trust  
J.A. Siwach, Dynamics of Indian Government & Politics
- 3) D.C. Gupta, Indian Government and Politics
- 4) H.M. Sreevai, Constitutional Law of India, 4th edition in 3 volumes (Universal Law Publication)
- 5) J.C. Johari, Indian Government and Politics Hans
- 6) J. Raj Indian Government and Politics
- 7) M.V. Pylee, Indian Constitution Durga Das Basu, Human Rights in Constitutional Law, Prentice–Hall of India Pvt. Ltd, New Delhi
- 8) Noorani, A.G., (South Asia Human Rights Documentation Centre), Challenges to Civil Right),Challenges to Civil Rights Guarantees in India, Oxford University Press 2012



