

**Integral University, Lucknow**  
**Integral Institute of Agricultural Science and Technology**  
**Evaluation Scheme of Undergraduate program**  
**B. Tech. Agricultural Engineering**  
**w.e.f. Session 2017-18**

**Semester - IV**

| Course Code | Subject   | Periods Per h/week/sem |   |           | Evaluation Scheme Theory Mid sem |    |                    | Evaluation Scheme Practical Examination |    |                    |   |   | End sem Theory Exam <sup>(d)</sup> | Subject total <sup>(e=a+b+c+d)</sup> | Credit | Total Credit Points |
|-------------|---|------------------------|---|-----------|----------------------------------|----|--------------------|---|----|--------------------|---|---|------------------------------------|--------------------------------------|--------|---------------------|
|             |   |                        |   |           |                                  |    |                    | Sessional                               |    |                    | End sem exam (Taken by external examiner) | Sub Total (sessional + exam) <sup>b+c</sup> |                                    |                                      |        |                     |
|             |   | L                      | T | P         | CT                               | TA | Total <sup>a</sup> | CT                                      | TA | Total <sup>b</sup> |   |   |                                    |                                      |        |                     |
| AE240       | Tractor Systems and Controls                                      | 2                      | 0 | 2         | 10                               | 10 | 20                 | 5                                       | 5  | 10                 | 20  | 30  | 50                                 | 100                                  | 2:0:1  | 3                   |
| AE241       | Farm Machinery and Equipment-II                                   | 2                      | 0 | 2         | 10                               | 10 | 20                 | 5                                       | 5  | 10                 | 20  | 30  | 50                                 | 100                                  | 2:0:1  | 3                   |
| AE242       | Renewable Energy Sources  | 2                      | 0 | 2         | 10                               | 10 | 20                 | 5                                       | 5  | 10                 | 20  | 30  | 50                                 | 100                                  | 2:0:1  | 3                   |
| AE243       | Irrigation Engineering  | 3                      | 0 | 2         | 10                               | 10 | 20                 | 5                                       | 5  | 10                 | 20  | 30  | 50                                 | 100                                  | 3:0:1  | 4                   |
| AE244       | Crop Process Engineering  | 2                      | 0 | 2         | 10                               | 10 | 20                 | 5                                       | 5  | 10                 | 20  | 30  | 50                                 | 100                                  | 2:0:1  | 3                   |
| ME226       | Fluid Mechanics   | 2                      | 0 | 2         | 10                               | 10 | 20                 | 5                                       | 5  | 10                 | 20  | 30  | 50                                 | 100                                  | 2:0:1  | 3                   |
| ME227       | Theory of Machines  | 2                      | 0 | 2         | 10                               | 10 | 20                 | 5                                       | 5  | 10                 | 20  | 30  | 50                                 | 100                                  | 2:0:1  | 3                   |
| AE245       | Field Operation and Maintenance of Tractors and Farm Machinery-II | 1                      | 0 | 2         | 10                               | 10 | 20                 | 5                                       | 5  | 10                 | 20  | 30  | 50                                 | 100                                  | 1:0:1  | 2                   |
|             | <b>Total</b>  | <b>16</b>              |   | <b>16</b> |                                  |    |                    |   |    |                    |   |   |                                    |                                      |        | <b>24</b>           |

**a**  
**Theory mid sem (20 marks) = Mid sem/makeup (10 marks) + Quiz 1 (2.5 marks) + Quiz 2 (2.5 marks) + Attendance (5 marks)**

**b**  
**Practical mid sem (10 marks) = CT (5 marks) + TA (2.5 marks) + Attendance (2.5 marks)**

**c**  
**End sem exam practical (Taken by external examiner) = 20 marks**

**d**  
**End sem final theory = 100 marks (40 marks objective type and 60 marks subjective type questions) to be scaled down to 50% in subjects with practicals and 80% in subjects without practicals**

**B. Tech. Agricultural Engineering**  
**SEMESTER-IV**  
**Syllabus: Tractor Systems and Controls**  
**Paper Code: AE240**  
**w.e.f. Session 2017-18**

**3 (2+1)**

**Unit 1**

Study of transmission systems like cooling system, lubrication system, power transmission system, hydraulic system, fuel supply system, steering system, hitching system and electrical system.

**Unit 2**

Clutch, types of clutch its operation and control, Gear box, different types of gear box its operation and control, differential, purpose, operation, control and final drive mechanism.

**Unit 3**

Familiarization of brake mechanism, types of brake, brake system in tractors its operation and control, Brake shoes, types of brake shoes, Brake shoes materials and its proportions.

**Unit 4**

Ackerman and hydraulic steering and hydraulic systems, its operation and control. Types of steering and hydraulic system, hydraulic pumps and its types, forces acting on hydraulic oil, types of fluids and flow of hydraulic oil in tractors. Tractor power outlets: P.T.O. (Power take off), belt pulley, drawbar, etc. Tractor chassis mechanics and design for tractor stability, Ergonomic considerations and operational safety.

**Practical:** Introduction to transmission systems and components; Study of clutch functioning, parts and design problem on clutch system; Study of different types of gear box, calculation of speed ratios, design problems on gear box; Study on differential and final drive and planetary gears; Study of brake systems and some design problems; Steering geometry and adjustments; Study of hydraulic systems in a tractor, hydraulic trailer and some design problems; Traction performance of a tractor wheel; Finding C.G. of a tractor by weighing technique; Finding CG of a tractor using suspension/balancing techniques; Finding moment of Inertia of a tractor; Appraisal of various controls in different makes tractors in relation to anthropometric measurements.

**Recommended Books**

1. Gupta, R.B., and Gupta, B.K. (1987). Tractor Mechanic, Theory, Maintenance and Repair. Sathya Prakashan and Tech India Publications, New Delhi.
2. Jain, S.C., and Rai, C.R. (1984). Farm Tractor - Maintenance and Repair. Tata McGraw- Hill Publishing Company Ltd, New Delhi.
3. Liljedahl John, B., Casleton Walter, M., Turnquist Paul, K., and Smith David, W. (1951). Tractors and Their Power Units, John Wiley & Sons, New-York.
4. Mathus, M.L., and Sharma, R.P. (1994). A Course in Internal Combustion Engines. Danpat Rai & Sons, Delhi.

**B. Tech. Agricultural Engineering**  
**SEMESTER-IV**  
**Syllabus: Farm Machinery and Equipment-II**  
**Paper Code: AE241**  
**w.e.f. Session 2017-18**

**3 (2+1)**

**Unit 1**

Principles and types of cutting mechanisms. Construction & adjustments of shear & impact type cutting mechanisms. Crop harvesting machinery: mowers, windrowers, reapers, reaper binders and forage harvesters.

**Unit 2**

Forage chopping & handling equipment. Threshing mechanics & various types of threshers. Threshers, straw combines &- grain combines, maize harvesting & shelling equipment, Root crop harvesting equipment potato, groundnut etc., Cotton picking.

**Unit 3**

Sugarcane harvesting equipment. Principles of plantation crops and fruit harvesting tools and machines. Horticultural tools and gadgets. Testing of farm machine. Test codes & procedure.

**Unit 4**

Interpretation of test results. Selection and management of farm machines for optimum performance.

**Practical:** Familiarization with various Farm machines related to harvesting, threshing, root harvesting, combine etc; Study of various types of mowers, constructional details, materials and working; Study of various types of reaper, constructional details, materials and working and performance; Study of various

types of reaper binder, constructional details, materials and working; Study of various types of potato harvesters, constructional details, materials and working; Study of various types of groundnut harvesters, constructional details, materials and working and performance; Study of various types of forage harvester, constructional details, materials and working; Study of various types of sugarcane harvester, constructional details, materials and working; Study of various types of maize sheller, constructional details, materials and working and performance; Study of various types of threshers, constructional details, materials and working and performance; Study of various types of cotton pickers and strippers, constructional details, materials and working; Study of various types of harvester tools, constructional details, materials and working; Study of various types of combine harvester, constructional details, materials and working; Study of various types of straw combines, constructional details, materials and working; Study of various types of fruit harvester equipment, constructional details, materials and working.

### **Recommended Books**

1. Ghosh, P.K, and Swain, S. (1993). Practical Agricultural Engineering. Naya Prokash, Calcutta.
2. Kelnin, N.I., Popov, I.F., and Sakun, V.A. (1985). Agricultural Machines. Amerind Publishers, New Delhi.
3. Srivastava, A.C. (1990). Elements of Farm Machinery. Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.
4. Kepner, R.A., Bainer Roy, and Barges,- E.C. (1978). Principals of Farm Machinery, CBS Publishers and Distributors, Delhi 17.

## **B. Tech. Agricultural Engineering**

### **SEMESTER-IV**

#### **Syllabus: Renewable Energy Sources**

**Paper Code: AE242**

**w.e.f. Session 2017-18**

**3 (2+1)**

#### **Unit 1**

Energy sources, Introduction, Classification, Energy from Biomass, Types of biogas plants, constructional details, Principles of combustion, pyrolysis and gasification.

#### **Unit 2**

Types of gasifiers and Briquetting, Types of Briquetting machines, Wind energy, Types of wind mills, Constructional details and application of wind mills; Modern applications and future potential of renewable energy sources.

#### **Unit 3**

Solar energy, Solar flat plate and focusing plate collectors, Solar air heaters, Solar space heating and cooling, Solar energy applications / Solar energy gadgets, Solar cookers, Solar water heating systems, solar grain dryers, Solar Refrigeration system, Solar ponds, Solar photo voltaic systems, solar lantern, Solar street lights, solar fencing, Solar pumping systems.

#### **Unit 4**

Brief introduction to wind energy, hydroelectric energy, ocean energy, briquetting and baling of biomass, biomass combustion, biodiesel preparation and energy conservation in agriculture.

**Practical:** Preparation of biomass sample; Determination of calorific value; Estimation of ash content of biomass; Estimation of moisture content of

biomass; Estimation of fixed carbon and volatile matter of biomass; Demonstration of down draft throatless rice husk gasifier; Demonstration of down draft gasifier with throat; Demonstration of rice husk gasifier for thermal use; Demonstration of working of a fixed dome type biogas plants; Demonstration of working of a floating drum type biogas plants; Demonstration of biodiesel preparation; Measurement of basic solar parameters; Demonstration of solar water heater; Demonstration of PVC; Demonstration of solar cooker; Determination of fuel properties.

### **Recommended Books**

1. Sukathme, S.P. (1996). Solar Energy. Tata McGraw Hill Publishing Company Ltd., New Delhi.
2. Rathore N. S., Kurchania A. K., Panwar N. L. 2007. Renewable Energy, Theory and Practice, Himanshu Publications.
3. Sukhatme, S.P. and Nayak, J.K. 2012. Solar Energy: Principles of Thermal Collection and Storage, Tata Mc-Graw Hill Education Pvt. Ltd., New Delhi
4. Tiwari, G.N. and Ghoshal, M.K. 2005. Renewable Energy Resources: Basic Principles and Applications. Narosa Pub. House. Delhi.

**B. Tech. Agricultural Engineering**  
**SEMESTER-IV**

**Syllabus: Irrigation Engineering**

**Paper Code: AE243**

**w.e.f. Session 2017-18**

**4 (3+1)**

**Unit 1**

Irrigation engineering and its impact on human environment, water resources utilization & Irrigation development, Major and medium irrigation schemes of India, purpose of irrigation, environmental impact of irrigation projects, source of irrigation water, measurement of irrigation water: weir, flumes, orifices and other methods.

**Unit 2**

Open channel water conveyance system: design and lining of irrigation field channels. On farm structures for water conveyance, control & distribution; underground pipe conveyance system: components and design; land grading: criteria for land levelling, land levelling design methods, estimation of earth work.

**Unit 3**

Soil water plant relationship: soil properties influencing irrigation management, soil water movement, infiltration, soil water potential, soil moisture characteristics, soil moisture constants, measurement of soil moisture, moisture stress and plant response; water requirement of crops: concept of evapotranspiration (ET), measurement and estimation of ET.

**Unit 4**

Surface irrigation methods of water application, border, check basin, furrow and contour irrigation; sprinkler and drip irrigation method, merits, demerits, selection



and design. Command- area concepts and components, irrigation terminologies relevant to command area, on farm development works, farmer participation in water distribution, water delivery methods, and design of unlined alluvial channels silt theories, design of lined channels, and materials for lining.

## **Unit 5**

Irrigation requirement of crops, depth of irrigation, frequency of irrigation, irrigation efficiencies Surface methods of water application: border, check basin and furrow irrigation adaptability, specification and design considerations.

**Practical:** Measurement of soil moisture by different soil moisture measuring instruments; measurement of irrigation water; measurement of infiltration rate; computation of evaporation and transpiration; land grading exercises; design of underground pipe line system; infiltration-advance in border irrigation; measurement of advance and recession in border irrigation and estimation of irrigation efficiency; measurement of advance and recession in furrow irrigation and estimation of irrigation efficiency; measurement of uniformity coefficient of sprinkler irrigation method; measurement of uniformity coefficient of drip irrigation method; field problems and remedial measures for sprinkler and drip irrigation method.

## **Recommended Books**

1. Majumdar D. K. 2013. Irrigation Water Management Principles. PHI learning Private Limited New Delhi 2nd Edition.
2. Michael A.M. 2012. Irrigation: Theory and Practice. Vikas Publishing House New Delhi.
3. Murthy VVN. 2013. Land and Water Management Engineering. Kalyani Publishers, New Delhi.
4. Suresh, R., 2010 "Principles of Micro-Irrigation Engineering", Standard Publishers Distributors, New Delhi

**B. Tech. Agricultural Engineering**  
**SEMESTER-IV**

**Syllabus: Crop Process Engineering**

**Paper Code: AE244**

**w.e.f. Session 2017-18**

**3 (2+1)**

**Unit 1**

Scope and importance of food processing, post-harvest losses, principles and methods of food processing. Processing of farm crops: cereals, pulses, oil seeds, fruits and vegetables and their products for food and feed. Processing of animal products, minimal processing.

**Unit 2**

Principle of size reduction, grain shape, size reduction machines; crushers, grinders, cutting machines etc. operation, efficiency and power requirement - Rittinger's, Kick' s and Bond' s equation, fineness modulus.

**Unit 3**

Theory of mixing, types of mixtures for dry and paste materials, rate of mixing and power requirement, mixing index. Theory of separation, size and un-sized separation, types of separators, size of screens, sieve analysis, capacity and effectiveness of screens, pneumatic separation.

**Unit 4**

Theory of filtration, study of different types of filters, rate of filtration, pressure drop during filtration. Scope and importance of material handling devices, study of different types of material handling systems: belt, chain and screw conveyor, bucket elevator, pneumatic conveying, gravity conveyor design consideration, capacity and power requirement.

**Practical:** Preparation of flow and layout charts of a food processing plant; Determination of fineness modulus and uniformity index; Performance evaluation of hammer mill; Performance evaluation of attrition mill; Study of cleaning equipment; Separation behaviour in pneumatic separation; Study of grading equipment; Evaluation of performance of indented cylinder and screen pre-cleaner; Mixing index and study of mixers; Study of conveying equipments; Performance evaluation of bucket elevator.

### **Recommended Books**

1. Chakravarty, A . (1995). Post Harvest technology of Cereals, Pulses and Oil Seeds. Oxford and IBH Pub.Co., Calcutta.
2. Fellows, P . (1993). Food Processing technology, Principles and Practice. Ellis Horwood, USA.
3. Majumdar, A.S . (2000). Drying Technology in Agriculture & Food Science. Oxford and IBH Publishing House.
4. Singh, K.K., Sahay K.M., Unit operations of agricultural processing.

**B. Tech. Agricultural Engineering**  
**SEMESTER-IV**

**Syllabus: Fluid Mechanics**

**Paper Code: ME226**

**w.e.f. Session 2017-18**

**3 (2+1)**

**Unit 1**

Properties of fluids: Ideal and real fluid. Pressure and its measurement, Pascal's law, pressure forces on plane and curved surfaces, centre of pressure, buoyancy, metacentre and metacentric height, condition of floatation and stability of submerged and floating bodies.

**Unit 2**

Kinematics of fluid flow: Lagrangian and Eulerian description of fluid motion, continuity equation, path lines, streak lines and stream lines, stream function, velocity potential and flow net. Types of fluid flow, translation, rotation, circulation and vorticity, Vortex motion.

**Unit 3**

Dynamics of fluid flow, Bernoulli's theorem, venturimeter, orifice-meter and nozzle, siphon; Laminar flow: Stress-strain relationships, flow between infinite parallel plates - both plates fixed, one plate moving, discharge, average velocity, shear stress and pressure gradient

**Unit 4**

Laminar and turbulent flow in pipes, general equation for head loss-Darcy, Equation, Moody's diagram, Minor and major hydraulic losses through pipes and fittings, flow through network of pipes, hydraulic gradient and energy gradient, power transmission through pipe; Dimensional analysis and similitude:

Rayleigh' s method and Buckingham' s `Pi' theorem, types of similarities, dimensional analysis, dimensionless numbers. Introduction to fluid machinery.

**Practical:** Study of manometers and pressure gauges; Verification of Bernoulli's theorem; Determination of coefficient of discharge of venturimeter and orifice meter; Determination of coefficient of friction in pipeline; Determination of coefficient of discharge for rectangular and triangular notch; Determination of coefficient of discharge, coefficient of velocity and coefficient of contraction for flow through orifice; Determination of coefficient of discharge for mouth piece; Measurement of force exerted by water-jets on flat and hemispherical vanes; Determination of metacentric height; Determination of efficiency of hydraulic ram; Performance evaluation of Pelton and Francis turbine; Study of current meter; Velocity distribution in open channels and determination of Manning's coefficient of rugosity.

### **Recommended Books**

1. Bansal, R.K. (1998). Fluid Mechanics and Hydraulic Machines. Laxmi Publications, Mad ras.
2. Frank M White. (2003). Fluid Mechanics. Tata Mc Graw Hill Publishers.
3. Grade, R.J. (1992). Fluid mechanics through problems. Wiley Eastern Ltd. Madras.
4. Shotri P V (2013). Fluid Mechanics

## **B. Tech. Agricultural Engineering**

### **SEMESTER-IV**

#### **Syllabus: Theory of Machines**

**Paper Code: ME227**

**w.e.f. Session 2017-18**

**3 (2+1)**

#### **Unit 1**

Elements, links, pairs, kinematics chain, and mechanisms. Classification of pairs and mechanisms. Lower and higher pairs. Four bar chain, slider crank chain and their inversions.

#### **Unit 2**

Determination of velocity and acceleration using graphical (relative velocity and acceleration) method. Instantaneous- centers. Turning moment diagrams, coefficient of fluctuation of speed and energy, weight of flywheel, flywheel applications.

#### **Unit 3**

Types of gears. Law of gearing, velocity of sliding between two teeth in mesh. Involute and cycloidal profile for gear teeth. Spur gear, nomenclature, interference and undercutting. Introduction to helical, spiral, bevel and worm gear. Simple, compound, reverted, and epicyclic trains. Determining velocity ratio by tabular method.

#### **Unit 4**

Belt drives, types of drives, belt materials. Length of belt, power transmitted, velocity ratio, belt size for flat and V belts. Effect of centrifugal tension, creep and slip on power transmission. Chain drives. Types of friction, laws of dry friction. Friction of pivots and collars. Single disc and multiple disc clutches. Types of governors. constructional details and analysis of Watt, Porter, Proell

-governors. Effect of friction, controlling force curves. Sensitiveness, stability, hunting, isochronism, power and effort of a governor.

## **Unit 5**

Types of governors. Constructional details and analysis of Watt, Porter, Proell governors. Effect of friction, controlling force curves. Sensitiveness, stability, hunting, isochronism, power and effort of a governor. Static and dynamic balancing. Balancing of rotating masses in one and different planes. Partial primary balancing of reciprocating masses.

**Practical:** Demonstration in mechanisms study using models; Analysis of 4-bar mechanism, slider crank mechanism and their inversions; Complete velocity and acceleration analysis (Graphical or Analytical) of few practical linkage mechanisms; Study of gears and gear trains and motion analysis of some practical complex compound gear train; Motion analysis Epicyclical gear trains using tabular and formula methods; To design a compound gear train and epicyclic gear train for a desired speed ratio; Practical test; To study the flywheel and governor action in laboratory; To graphically synthesize the cam profile for a desired standard follower motion; Study on the cam follower demonstration machine for follower displacement as a function of cam rotation angle and phenomenon of follower jump; Demonstration of static and dynamic balancing in the laboratory. Calculations on balancing a multi rotor unbalanced system by putting masses in two different planes.

## **Recommended Books**

1. Balleney, P.L. Theory of Machines. ,Khanna Publishers, New Delhi.
2. Kurmi R.S. Theory of machines. S.Chand publications., New Delhi.
3. Rattan, S.S. Theory of Machines. Tata Mc Graw Hill Publishing Company Limited. New Delhi.
4. Bansal R.K. and Brar J.S.A (2016) Textbook of Theory of Machines Paperback.

**B. Tech. Agricultural Engineering**  
**SEMESTER-IV**

**Syllabus: Field Operation and Maintenance of Tractors and Farm Machinery-II**

**Paper Code: AE245**

**w.e.f. Session 2017-18**

**2 (1+1)**

**Unit 1**

Introduction to tractor maintenance procedure and trouble shooting. Scheduled maintenance after 10, 50, 100, 250, 500 and 1000 hrs of operation. Safety hints. Top end overhauling. Overhauling of fuel tank, mechanical fuel Pump, electrical pump, fuel filters, carburetors Testing of fuel pumps for proper functioning

**Unit 2**

Introduction of fuel saving by idle away, air conditioning, use overdrive, observe the speed limit, tire pressure, reduce weight, regular care and constant speed, preparing the tractor for storage.

**Unit 3**

Care and maintenance procedure of agricultural machinery during operation and off-season. Maintenance, Servicing of different types of air cleaner, turbocharger, intercooler, throttle body, intake manifold, exhaust systems, exhaust manifold, catalytic converter, resonator and muffler.

**Unit 4**

Maintenance, diagnosis and servicing of basic petrol fuel system components, conventional diesel fuel system and its components, lubrication system, cooling system and servicing battery. Maintenance and servicing of starting system, charging system. and conventional ignition system. Repair and maintenance of workshop requirements.

**Practical:** Familiarization with tools and equipment used for maintaining and servicing of tractors and farm machines; Doing the 10-hours service jobs and Maintenance after 50-hours of operation; Maintenance after 100 hours of operation; Maintenance after 250 hours of operation; Maintenance after 500 hours and 1000 hours of operation, adjustment of tractor track; Dismantling and assembling of major engine parts; Visit to tractor/engine repair workshop,



injection pump injector repair shop; Doing minor repair of electric, mechanical and hydraulic system; Adjustment and maintenance of primary and secondary tillage equipment viz. m.b. plough, disc-plough and disc harrow etc.; Adjustment and maintenance of seeding and planting and transplanting machines; Adjustment and maintenance of plant protection equipment; Adjustment and maintenance of reapers and threshers; Adjustment and maintenance of combine harvesters, straw combines, balers etc; Visit to small scale farm machinery manufacturers and their repair shops, seasonal repair of farm machinery.

### **Recommended Books**

1. Gupta, R.B., and Gupta, B.K. (1987). Tractor Mechanic, Theory, Maintenance and Repair, Sathya Prakashan and Tech India Publications, New Delhi.
2. Jain, S.C., and Rai, C.R. (1984). Farm Tractor - Maintenance and Repair. Tata McGraw- Hill Publishing Company Ltd, New Delhi.
3. Liljedahl John, B., Casleton Walter, M., Turnquist Paul, K., and Smith David, W. (1951). Tractors and Their Power Units, John Wiley & Sons, New-York.
4. Mathus, M.L., and Sharma, R.P. (1994). A Course in Internal Combustion Engines. Danpat Rai & Sons, Delhi.