JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AGRICULTURAL ENGINEERING

COURSE STRUCTURE AND SYLLABUS

For

B. TECH AGRICUTLTURAL ENGINEERING

(Applicable for batches admitted from 2019-2020)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

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DEPARTMENT OF AGRICULTURAL ENGINEERING

IV Year I Semester

S. No.	Subject	L	T	P	Credits
1	Micro Irrigation Engineering	3	0	0	3
2	Post Harvest Engineering for Horticulture Produce	3	0	0	3
3	**Open Elective - II** 1. Mechanical Measurements and Instrumentation 2. Artificial Intelligence in Agricultural Engineering 3. Photovoltaic Technology and Systems	3	0	0	3
4	**Professional Elective – II** 1. Food Packaging Technology 2. Watershed Management 3. Human Engineering and Safety	3	0	0	3
5	**Professional Elective – III** 1. GIS and Remote Sensing 2. Production Technology of Agricultural Machinery 3. Food Plant Design and Management	3	0	0	3
6	Farm Machinery Lab - II	0	0	3	1.5
7	Summer In-Plant Training/Internship (After 6th Semester) for 4 weeks	0	0	2	1
8	Research Project – Part - I	0	0	3	1.5
	Total Credits				**19.0**

IV Year II Semester

S. No.	Subject	L	T	P	Credits
1	**Open Elective – III** 1. Design of Agricultural Machinery 2. Food Quality and Control 3. Industrial Pollution Control Engineering	3	0	0	3
2	**Open Elective - IV** 1. Agro Industries and By-Products Utilization 2. Hydraulic Devices and Controls 3. Water Resource System Planning and Management	3	0	0	3
3	**Professional Elective – IV** 1. Design of Soil and Water Conservation and Form Systems 2. Process Equipment Design 3. Digital Control Systems	3	0	0	3
4	Agricultural Extension Techniques and Business Management	3	0	0	3
5	Seminar	0	0	3	1.5
6	Research Project – Part - II	0	0	11	5.5
	Total Credits				**19**

IV Year B.Tech. Ag. Engg II Sem.		L	T/P	C
		3	0/0	3

DESIGN OF AGRICULTURAL MACHINERY

(Open Elective –III)

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.

Outcomes:

Imports knowledge on various moving and non-moving elements of agricultural machinery.

Explains the laws, forces, stress, storm and factors involved in agricultural machines.

Explain the levers, springs, material and construction procedure.

Imports knowledge on designing of various types of shatts and keys.

Apply the knowledge for designing of agricultural machines.

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). Design of Sowing Machinery – Tractor Operated seed cum Fertilize drill. Design of harvesting equipment: a. Reaper, b. Mower. Design of Thresher: Power operated thresher (Spike tooth and Raspbar), Design of spraying equipment – Tractor mounted Boom sprayer.

TEXT BOOK:

1. Machine Design – Khurmi R.S. and Gupta J.K. 1996, Eurasia Publishing House Pvt. Ltd., New Delhi.

REFERENCES:

1. Machine Design – Jain R.K. 1991. Khanna Publishers, New Delhi.

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		3	0/0	3
Food Quality and Control (Open Elective –III)				

Objectives: To enable the students to understand the basics of food science, different quality parameters of food, laws and regulations governing food quality.

Course Outcomes:

1. Able to understand the basic of food science and food quality.
2. Helps in learning sampling techniques for testing of food products.
3. Gets an insight on subjective and objective methods of food quality testing.
4. Help in detection of food adulterants in food and food products for meeting quality standards and specifications.
5. Gives knowledge on food safety and sanitation management systems for food quality control.

UNIT I

Basics of Food Science and Food Analysis, Concept, objectives and need and scope of food quality – general concepts of quality control, major quality control functions. Measurement of colour, flavor, consistency, viscosity, texture and their relationship with food quality and composition.

UNIT II

Sampling: purpose, sampling techniques, sampling procedures for liquid, powdered and granular materials, Quality control: Quality control tools, Statistical considerations in sampling and quality control.

UNIT III

Sensory evaluation methods, panel selection methods, Interpretation of sensory results. Instrumental method for testing quality.

UNIT IV

Sources of contaminant and a septic handling of foods. Food adulteration and food safety. TQM and TQC consumer preferences and acceptance, Detection of adulteration and examination of various food products – ghee, spices, milk and milk products, fruit products (jams, jelly, marmalades) for quality standards and specifications.

UNIT V

Food Safety Management Systems GAP, GHP, GMP, Hazards and HACCP (Hazard analysis and critical control point), Sanitation in food industries. Sanitations and phytosanitory procedures in food industries. Food Laws and Regulations in India, FSSAI, Food grades and standards BIS, AGMARK, PFA, FPO, ISO 9000, 22000 Series. CAC (Codex Alimantarious Commission). Food processing laws – maintenance of records and reports – traceability and Quality Assurance system in a process plant. Food laws – Role of voluntary agencies and legal aspects of consumer protection.

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Text Book:

2. Ranganna S. 1986. Hand book of Analysis and Quality Control for Fruit and Vegetable Products. TMH, New Delhi.
3. Sharma Avanthi. 2006. A text book of Food Science and Technology, CBS Publishers, New Delhi.
4. The Food Safety and Standards Act along with Rules & Regulations. Commercial Law Publishers (India) Pvt. Ltd. New Delhi.

Reference Books:

1. Mumbai Sumati R., Rao Shalini M. and Rajagopal M.V.2006. Food Science, New Age, International, Hyderabad.
2. Potter N. N. and Hotchkiss J. H. 1995 Food Science, Springer, U.S.A.
3. Dev Raj, Rakesh Sharma and Joshi V. K. 2001. Quality Control for Value Addition in Food Processing. New India Publishing Agencies, Delhi.

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		3	0/0	3
INDUSTRIAL POLLUTION CONTROL ENGINEERING (Open Elective –III)				

Learning objective:

The student is acquainted with the various control methods and equipment required for control has been discussed for suitably designing the appropriate process and equipment for a given industrial pollutant.

Outcomes:

1. Student can learn about the effects of different emissions from chemical industries on environment.
2. It is helpful in knowing the methods of I ry & III ry treatment disposal.
3. Students will learn about the biological bacterial treatments to waste water.
4. It is useful in pollution sampling and measurement.
5. Students can be well acquitted with air pollution control method, cycle separation and different methods.

UNIT-I:

Types of emissions from chemical industries and effects of environment, environment legislation, type of pollution and their sources, effluent guidelines and standards. Characterization of effluent streams, Oxygen demands and their determination (BOD, COD, and TOC), oxygen sag curve, BOD curve mathematical, controlling of BOD curve, self-purification of running streams, sources and characteristics of pollutants in fertilizer, paper and pulp industry, petroleum and petroleum industry.

UNIT-II:

Methods of primary treatments: screening, sedimentation, flotation, neutralization, and methods of tertiary treatment. Brief studies of Carbon absorption, Ion exchange, Reverse osmosis, Ultra filtration, Chlorination, Ozonation, treatment and disposal

UNIT-III:

Introduction to waste water treatment, biological treatment of wastewater, bacterial and bacterial growth curve, aerobic processes, suspended growth processes, activated aerated lagoons and stabilization ponds, attached growth processes, trickling filters, rotary drum filters, and anaerobic processes.

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UNIT-IV:

Air pollution sampling and measurement: Types of pollutant sampling and measurement, ambient air sampling: collection of gaseous particulate air pollutants. Stack sampling: sampling system, particulate and gaseous sampling.

UNIT-V:

Air pollution control methods and equipments: Source collection methods: raw material changes, process changes, and equipment modification. Collection efficiency, control equipment like gravitational settling chambers, cyclone separators, fabric filters, ESP. scrubbers and absorption equipment

Text Book:

5. Environmental Pollution and Control Engineering, Rao C. S., Wiley Eastern Limited, India, 1993.

Reference Books:

4. Pollution Control in Process Industries, S.P. Mahajan, TMH., 1985.
5. Waste Water Treatment, M.Narayana Rao and A.K.Datta, 3rd Edition, Oxford and IHB, 2008.
6. Industrial Pollution Control and Engineering, Swamy AVN, Galgotia publications, 2005.

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		3	0/0	3
AGRO INDUSTRIES AND BI-PRODUCT UTILIZATION (Open Elective –IV)				

Objective: Processes to convert low value byproducts from agricultural and food processing industries will be explained in detail to produce economically viable value added products. Knowledge on treatment techniques of waste water from agricultural/food industry and animal sheds for safe disposal will be imparted to the students.

Course Outcomes:
Will have an idea about need and necessity of utilization of agro industries by products.
Gets knowledge on processes to convert low value by products from agricultural and food industries to value added products.
Gets information on utilization of agro industries waste for reverse such as feed, paper and briquests.
Understand the properties of agricultural waste.
Will get knowledge on treatment techniques of water waste from agricultural food industries and animal sheds for safe disposal.

Unit –I

Agro-industries-Definition, classification, factors responsible for establishment. By-products utilization-Rice husk-Introduction, characteristics, uses, production of pure silica and silicon, uses of amorphous silica, grades of silicon, structure of rice husk silica. Burning of rice husk for production of white ash, production of high purity silicon (calcium reduction process). Ceramic materials from rice husk – Classification of ceramics, advantages of rice husk white ash, raw materials for ceramics, production process, merits of process. Rice husk combustion – Furnace design calculation, efficiency of furnace, problems on rice husk combustion, design of inclined grate furnace.

Unit-II:

Rice husk – Alcoholic fermentation – Introduction, processes for manufacture of alcohol, production of ethyl alcohol by SSF process. Furfural – Chemistry, products properties of furfural, synthesis, production of furfural and xylose from corn cobs, furfural through RRL process. Rice bran – Oil extraction, food and chemical products processing. Coconut coir and shell utilization – Introduction. Commercial products – Edible copra, milling copra, oil milling, quality of copra and oil. Fresh kernel based products and product diversification – Desiccated coconut, canned coconut cream, coconut water. Coconut toddy production. Coir – Brown fiber milling, manufacture of white fiber. Coconut shell products.

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Unit –III:

Waste for Revsa: Mango stone and peel utilization – Mango vinegar, mango leather, mango flour-Cashew nut- Harvesting, processing. Cashew products – Nuts, testa, apple, cashew nut shell liquid, extraction of CNSL. Banana pseudo stem – Pseudo stem, banana stem candy, banana starch from pseudo stem, banana cheese from peel, banana pectin from peel, banana vinegar from pulp and peel, banana peel as cattle feed. Sugarcane bagasse – Molasses, bagasse, filter mud, sugarcane wax. Paper board Paper making from agricultural wastes – paper processing – Manufacture of pulp and paper. Raw materials for paper production. Feed processing plants – Introduction, feedstuffs from cereals, classification of feeds, specialized feeding requirements, feed manufacturing processes, forms of feed. Equipment for unit operations in feed processing – Liquid feed blenders, flaking, milling, mixing, pelleting and extruding. Formulating feeds, layout of feed mills for commercial production.

Unit-IV:

Properice of agricultural waste: Properties of agricultural waste – characteristics of solid and liquid wastes, parameter importance, determination of DO, COD, total organic carbon, BOD. BOD analysis of industrial waste waters, determination of BOD with seed material, problems on BOD. Waste collection, storage and handling – Collection, components of waste collection systems, storage of manures and slurries, factors affecting choice of storage facility. Waste handling and transport, pumping liquid manure, sumps and mixing, mixing and agitation. Industrial waste treatment – Physical treatment of waste – Solid-liquid separation – Settling, problems on solid-liquid separation, screening, drying, incineration and pyrolysis.

Unit –V:

Agricultural waste management: Biological treatment – Introduction. Anaerobic decomposition, lagoons, advantages and disadvantages, designing problems lagoon sludge. Aerobic treatment – Introduction, reactions, processes advantages and disadvantages types of aeration systems - Natural aeration mechanical aeration – Film reactors – Tricking filters, rotating biological contactors, problems on tricking filters. Floc reactors – Mechanically aerated lagoons, diffused air systems, Waste for reuse. Briquetting – Introduction, principle, briquetting machines. Processing – Direct compaction, carbonization and extrusion.

Text Books:

1. Modern Abattoir Practices and Animal by Products, Sharma, B.D, Jaypee Brothers medical Publishers.
2. Food from Wastes, Ervan, international Publishers,Delhi.

Reference Books:

1. Food Agricultural Waste Manual, Vandersholm D H, NewZealand.
2. Agricultural Waste Management Field Hand Book, USDA: New York,USA.
3. Manure Production and Characteristics. Standards, ASAE: Am. Soc. of Agricultural Engineers, New York.

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		3	0/0	3
Hydraulic Devices and Controls (Open Elective –IV)				

Objectives: To train the students in usage an operation of hydraulic and pneumatics controls required for automation of different engineering interventions in agriculture.

Outcomes:

1. Skill development on basic hydraulic laws, concets and filteration systems.
2. Skill development on Accumulators, Pressure genger, hydraulic circuits, different principles of sumps, construction and operation.
3. Skill development on hydraulic actuators & their principles & concepts, flow control values & their installations, circuit diagrams & trouble shooting.
4. Skill development on USCSI graphical symbols, tractor hydraulics, ADDC, pneumatic air services, logistic frameworl, hydraulic systems & pneumatic drivers and use of PLC in drivers' control.
5. Skill development on hydraulic systems, pumps & actuators, hydraulic circuits, pneumatic devices and their use in robotics.

UNIT I:
Hydraulic Basics: Pascal's Law, flow, energy, work, and power. Hydraulic systems, color coding, reservoirs strainers and filters, filtering material and elements.

UNIT II:
Accumulators, pressure gauges an volume meters, hydraulic circuit, fittings and connectors. Pumps, pump classifications, operation, performance, displacement, design of gear pumps, vane pumps, piston pumps.

UNIT III:
Hydraulic actuators, cylinders, construction and applications, maintenance, hydraulic motors. Valves, pressure-control valves, directional-control valves, flow-control valves, valve. Installation, valve failures and remedies, valve assemble, troubleshooting of valves hydraulic circuit diagrams and troubleshooting.

UNIT IV:
United States of American Standards Institute USASI Graphical Symbols Tractor hydraulics, nudging system, ADDC. Pneumatic: Air services, logic units, fail safe and safety systems robotics: application of hydraulics and pneumatics drives in agricultural systems, Programmable Logic Controls (PLCs).

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UNIT V:

Introduction to hydraulic systems. Study of hydraulic pumps, hydraulic actuators. Study of hydraulic motors, hydraulic valves, colour codes and circuits. Building simple hydraulic circuits, hydraulics in tractors. Introduction to pneumatics, pneumatics devices, pneumatics in agriculture; Use of hydraulics and pneumatics for robotics.

TEXT 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. Majumdar. 2001. Oil Hydraulic System. Tata Mc-Graw Hill, New Delhi.
3. Parr A.2005. Hydraulics and Pneumatics. Jaico Publishing House, Mumbai.

REFERENCES:

1. Esposoto Anthony. 2003 Hydraulic System. Tata Mc-Graw Hill, New Delhi.
2. Herbert E. Merritt. 1967. Hydraulic control Systems. John Wiley & Sons, New York.
3. John Deere. 1967. Fundamentals of Service Hydraulics.

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		3	0/0	3

WATER RESOURCES SYSTEM PLANNING AND MANAGEMENT

(Open Elective –IV)

Course Learning Objectives:
The course is designed to

1. Introduce the concepts of system analysis in the planning, design, and operation of water resources.
2. Appropriate mathematical optimization methods and models.
3. Learn and apply basic economic analysis tools to water resources projects.
4. Understand linear, nonlinear and dynamic programming techniques and apply them to various water resources systems planning and design problems.
5. Appropriate simulation and management techniques in water resources systems.

Course Outcomes
At the end of the course the student will be able to

a. Apply optimization methods to solve problems related to water resource systems.
b. Perform basic economic analysis to evaluate the economic feasibility of water resources projects
c. Formulate optimization models for decision making in water resources systems.
d. Use simulation models for planning and design of water resources systems.

UNIT – I
Introduction: Concepts of systems analysis, definition, systems approach to water resources planning and management, role of optimization models, objective function and constraints, types of optimization techniques.

UNIT – II
Simulation and management: Application of simulation techniques in water resources, planning of reservoir system, optimal operation of single reservoir system, allocation of water resources, optimal cropping pattern, conjunctive use of surface and ground water resources.
Linear programming: Formulation of linear programming models, graphical method, simplex method, application of linear programming in water resources, revised simplex method, duality in linear programming, sensitivity analysis.

UNIT – III
Dynamic programming: Principles of optimality, forward and backward recursive dynamic programming, curse of dimensionality, application for resource allocation.

UNIT – VI
Non-linear optimization techniques: Classical optimization techniques, lagrange methods, Kuhn-Tucker conditions, search techniques, overview of genetic algorithm

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UNIT – V

Water resources economics: Basics of engineering economics, economic analysis, conditions of project optimality, benefit and cost analysis

TEXT BOOKS:

1. 'Water Resources System Analysis' by Vedula S and P P Mujumdar, McGraw Hill Company Ltd, 2005.
2. 'Water Resources Economics' by James D and R. Lee, Oxford Publishers, 2005.

REFERENCES:

1. 'Water Resources Systems Planning and Management - An Introduction to Methods, Models and Applications' by Loucks D P and E V Bee, UNESCO Publications, 2005 (http://ecommons.cornell.edu/bitstream/1813/2804/21/00_intro.pdf)
2. 'Optimal design of water distribution networks' by Bhave, P. R, Narosa Publishing house, 2003.

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		3	0/0	3
DESIGN OF SOIL, WATER CONSERVATION AND FORM SYSTEMS **(Professional Elective –IV)**				

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.

Outcomes:

1. Skill development on principles of hydraulics of open channel flow, their design and construction in the field, critical energy concepts, froud number and its application in hydraulics.
2. Skill development in the principles of hydrologic, hydraulic of runoff measuring structures in the stream flow, seepage dynamic across the structures.
3. Acquaintance with knowledge on principles of design and construction of climate spills ways, inlet drop structures, pipe spill way etc., irrigation structures and their design & construction.
4. Skill acquiring in structures used in the aerial water conveying system, their principles, design and constructions & cross draining works.
5. Skill development on principles of irrigation outlets, their design and construction, diversion head works, different weirs and barrages.

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 basic 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.

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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.

TEXT BOOKS:

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:

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.

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		3	0/0	3
PROCESS EQUIPMENT DESIGN **(Professional Elective –IV)**				

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.

Course Outcomes:

1. Students gains knowledge on need ad factors to be considered in designing different food processing equipments.
2. Gets an idea about different types of materials specifications and design codes used for designing food process equipments.
3. Students gains information on designing of different types of supporting and accessory requirements food processing equipments.
4. Students will enable to design different types process equipment suitable for different foods.
5. Will enable the students how to calculate efficiency, energy and cost in designing of food process equipment.

UNIT I:

introduction on process equipment design - factors influencing the design of vessels criteria in vessel design – application of design engineering for processing equipments, 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 equipments design of shells and roofs – proporting, head selection, supporters, pressure and stress considerations in different process equipments – Design codes: design of different food process equipments 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 freege drivers. Design of milling equipments – pulverizers, flour mills – hand operated and mechanical mills – disc mills, rotary mills, dry and wet mills.

UNIT V:

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

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Text Book:

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.

Reference Books:

1. Mahajani, V.V. and Umarji, S.B.2009. Process Equipment design, Macmillan, U.K.
2. Rao, D.G.2010. Fundamentals of Food Engineering PHI Learning Pvt. Ltd, New Delhi.
3. Groover, M. and Zimmers, E. CAD/CAM Computer-aided design and manufacturing person Education, Inc., New Delhi.

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		3	0/0	3
DIGITAL CONTROL SYSTEMS (Professional Elective –IV)				

Objective:

In recent years digital controllers have become popular due to their capability of accurately performing complex computations at high speeds and versatility in leading non linear control systems. In this context, this course focuses on the analysis and design of digital control systems.

Course Outcomes:

1. The students learn the advantages of discrete time control systems and the "know how" of various associated accessories.
2. The learner understand z–transformations and their role in the mathematical analysis of different systems(like laplace transforms in analog systems).
3. The stability criterion for digital systems and methods adopted for testing the same are explained.
4. Finally, the conventional and state–space methods of design are also introduced.

UNIT – I:

Introduction and signal processing

Introduction to analog and digital control systems – advantages of digital systems – typical examples – signals and processing – sample and hold devices – sampling theorem and data reconstruction – frequency domain characteristics of zero order hold.

UNIT–II:

Z–transformations

Z–Transforms – theorems – finding inverse z–transforms – formulation of difference equations and solving – block diagram representation – pulse transfer functions and finding open loop and closed loop responses.

UNIT–III:

State space analysis and the concepts of controllability and observability

State space representation of discrete time systems – state transition matrix and methods of evaluation – discretization of continuous – time state equations – concepts of controllability and observability – tests(without proof).

UNIT – IV:

Stability analysis

Mapping between the S–Plane and the Z–Plane – primary strips and complementary strips – stability criterion – modified routh's stability criterion and jury's stability test.

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UNIT – V:

Design of discrete–time control systems by conventional methods and State feedback controllers:

Transient and steady state specifications – Design using frequency response in the w–plane for lag and led compensators – Root locus technique in the z–plane. Design of state feedback controller through pole placement – necessary and sufficient conditions – Ackerman's formula.

Text Book:

1. Discrete–Time Control systems – K. Ogata, Pearson Education/PHI, 2nd Edition

Reference Books:

1. Digital Control Systems, Kuo, Oxford University Press, 2nd Edition, 2003.
2. Digital Control and State Variable Methods by M.Gopal, TMH

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IV Year B.Tech. Ag. Engg II Sem.		L	T/P	C
		3	0/0	3
AGRICULTURAL EXTENSION TECHNIQUES AND BUSINESS MANAGEMENT				

Objective:
To develop the communication skills of student through various extension and management techniques. To improve the confident levels of the student by learning the international trade WTO and trade related intellectual property right (Trips) etc.

Course Outcomes:

1. Student can improve the improper the communication skills through various extension and management techniques.
2. It is useful to the student to know the various extension services through which the technologies are communicated to the farmers.
3. Student can be well admitted with management such an decision making, importance, planning, organization, control & co-relational etc.
4. It is useful for the students to start Agro based industries.
5. Students can be well acquainted with different trading system like international trade WTO and export & import policy.

Unit-I:

Describe the meaning of communication, explain models of communication process along with elements and their characteristics. Classify the methods and explain the meaning, objectives, procedure involved in carrying out various individual, group and mass contact methods and describe the factors influencing selection of extension methods.

Discuss about the various information tools and sources like internet, cyber cafes, kiosks, video and teleconferencing, Parishkaram (Farmers call Center) in A.P. and kisan call centers and agri-clinics including agricultural journalism.

Unit-II:

Discuss about the adoption and diffusion process and explain the models of adoption process and innovation- decision process, classify adopter categories and enlist the characteristics and explain the factors affecting adoption process. Describe the importance of capacity building of extension personnel and farmers and explain the meaning of training and discuss different types of training to farmers and enumerate the objectives of Farmer's Training Centre (FTC), mandate of Krishi Vignan Kendra (KVK) and objectives of District Agricultural Advisory and Transfer of Technology Centres (DAATTC).

Unit-III:

Management – Definition, decision management, importance of management, concepts, functions of management. Management – Management cycle, planning, organization, direction, control, co – ordination, communication. Agri – business management – Meaning, definition, concept, distinctive features of agribusiness management, application of management principles in agri – business.

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Unit-IV:

Agro – based industries – Importance, need, procedure to be followed to setup agro – based industries, constraints in establishing agro – based industries. Project analysis – Project meaning, project cycle, identification, formulation, appraisal, Implementation, monitoring and evaluation. Project appraisal techniques – Undisounted techniques, pay back method, rate of return/return on investment, etc. Discounted techniques – NPV, BCR, IRR, sensitivity analysis.

Unit-V:

International trade – Definition, comparison between international trade and interregional trade, free trade vs. protectionism, methods of protectionism. India's contribution to international trade in food and agricultural commodities, share of agricultural products in total imports/exports of India, export – import policy. General agreement on trade and tariff (GATT), WTO, objectives, functions and structure of WTO, why WTO, ten benefits of WTO. Principles of WTO trading systems, MFN, national treatment, predictability, promoting fair competition, encouraging development and economic reform. WTO agreements – Provisions relate to agreements in agricultural and food commodities. Agreements on agriculture (AOA) – Domestic supply, market access, export subsidies agreements on sanitary and phyto – sanitary (SPS) measures, Trade related intellectual propert5y rights (TRIPS).

References:

1. Education and Communication for Development, Dahama O.P. and Bhatnagar O.P 1980 – Ofxford& IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Reaching the Unreached – Basics of Extension Education, Ganesh R., Mohammad Iqbal I. and Anandaraja N., Associated Publishing Company, New Delhi.
3. Essentials of Management, Joseph L Massie 1995. Prentice – Hall of India, New Delhi.
4. Agricultural Economics and Agri–business, Omri Rawlins N 1980. Prentice – Hall Inc., New Jersey.

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IV Year B.Tech. Ag. Engg II Sem.		L	T/P	C
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IV Year B.Tech. Ag. Engg II Sem.		L	T/P	C
		0	0/11	5.5
Research Project – Part -II				