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**

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IV Year B.Tech. Ag. Engg I Sem.		L	T/P	C
		3	-/-	3
MICRO IRRIGATION ENGINEERING				

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.

Outcomes:

Skill development on historical development of sprinkler irrigation in India & AP; components of sprinkler irrigation system.

Knowledge Acquiring on type of sprinkler irrigation systems, preaprtitation profiles & its distribution, its distribution due to wind, estimation of different uniformity, crop suitability under sprinkler systems.

Skill development on the design and layout of sprinkler irrigation systems, its hydraulic and pump selection principles.

Skill development on history of design of drip irrigation in India & AP, components of the drip[system, friction losses in pipe lines.

Skill development on the principles of emitting deices & their principles, construction details, hydraulic pressure variables along with principles, design of drip irrigation system, layout and automation of DIS & principles.

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.

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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, venturi 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, Pressure and Hydrostatic, Pressure due to gravity, Friction and pressure losses, Coefficient of friction.

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)on-line, 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 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.

BOOKS:

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.

REFERENCES:

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.

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		3	-/-	3
POST HARVEST ENGINEERING AND HORTICULTURAL PRODUCE				

Objective:
To enable the students to acquaint with processing of fruits and vegetables, methos of handling processing, transport, storage, preservation and packing to minimize pre and post harvest losses of fruits and vegetables and their products.

Outcomes:
1. Will have knowledge on pre and post harvest quality of fruits and vegetables.
2. Gives an insight on handling and transportation of fruits and vegetables.
3. Will have knowledge on post-harvest processing and storage of fruits and vegetables.
4. Gets knowledge on methods of preparation of fruit and vegetable products.
5. Enable the student to learn the procedure for preservation and packaging of fruits and vegetables and their products.

Unit – I:

Factors affecting fruit and vegetable quality, pre-harvest factors, environmental factors, cultural factors, post harvest factors, Engineering properties of fruits and vegetables, physical properties, chemical properties, dry coefficient terminal velocity rheological properties, screen stain, mechanical properties, comprehension strength, tensile strength, shear resistance, electrical properties, optical properties, dielectric properties- light transmittance and light reflectance,

Unit-II:

Handling and transportation of fruits and vegetables. Harvesting indices of different fruits and vegetables, determination of maturity standards for fruits and vegetable- size, shapes, aroma, Fruit ripening, leaf changes, firmness, juice content, sugar content, skin colour, total soluble solid, modern techniques for determination of harvesting indices/ and grading of fruits, electrical property, near infrared reflectance (NIR), radiation, optical method, light reflectance, machine vision. Cleaning & washing- by agitator, by spraying water, wet and dry brushing, chemical washing, factors affecting effectiveness of a sprayer.

Unit – III:

Post harvest management of Fruits and vegetables, procurement centers, washing and grading, pre-cooling, room cooling, hydro cooling, transportation by refrigerated trucks, centralized cold storage centers etc, Controlled atmospheric storage, effects of CA, additional benefits, limitations, maintaining CA system, modified atmosphere storage, maintenance of MAP, active modification, passive modification, Requirements of fresh fruits package under CAS or MAS.

Unit – IV:

Canning of fruits & vegetables: soaking, rinsing, grading, washing, peeling, cutting, blanching, cooling, filling, brining, exhausting, sealing, heat processing, cooling to room temp, storage, labeling, making of cans for canning, causes of spoilage of canned foods, hydrogen swell, flipper, soft swell, hard swell, buckling, principles of preservation of fruits & vegetables, asepsis packaging, preservation by high temperature. pasteurization, flash

pasteurization, sterilization, chemical preservation with sulphur dioxide, advantages, disadvantages, preservation with benzoic acid, concentration and reverse osmosis technique applied to fruits & vegetables, drying and dehydration of fruits & vegetables (Flow chart), types of dryers, cabinet dryer, tray dryers, tunnel dryer, reconstitution test and rehydration, ratio of rehydration coefficient, freeze drying, methods of freezing, slow freezing, quick freezing method, advantages and disadvantages, direct immersion, indirect contact with refrigerant, air blast freezing, cryogenic freezing, de-hydro freezing, freeze-drying (flow chart).

Fermented beverages, wine, flow sheet for processing of grape wine, selection of fruit, crushing, addition of sugar, adjustment of PH, addition of preservative addition of wine yeast, fermentation, firing & filtration, aging, packaging, preparation of vinegar, alcoholic fermentation, acetic acid fermentation, quality characteristics of fruits and vegetable for processing, sensory, hidden and quantitative characteristics, oleoresin and essential oil extraction, turmeric oleoresin, extraction of chilli oleoresin, factors responsible, Solvents used for oleoresin extraction, advantages and disadvantages, Extraction of essential oil from spices by steam distillation, flow chart.

Unit-V:

Packaging of fruits and vegetables, packaging of fresh fruits, advantages of fresh packaging, packaging materials, cello pave, poly vinyl chloride, polyethylene, ethyl vinyl alcohol, packaging of apples, oranges, mangoes, bananas etc, preparation of preservation of unfermented fruit beverages, selection of fruit, sorting and washing, juice extraction, de-aeration, filtration, clarification, addition of sugar, fortification, preservation, baffling, unfermented beverages, apple juice, grape juice, pineapple juice, citrus juice, mango juice, with all flow charts.

TEXT BOOKS:

1. Food Science by Potter, N. CBS Publishers.
2. Fruits and Vegetable Preservation. Principles and practices by srivastava R P & Kumar S International book distributy C.

REFERENCE BOOK:

1. Fruits: Tropical and subtropical by Bose T. K &Mitre, SK Naya Prakash.
2. Fruits and Vegetable processing by Bhatti, S and varma U CBS Publishers.
3. Technology of food preservation by Defroshier and Defrossier CBS Publications.

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		3	-/-	3
MECHANICAL MEASUREMENTS AND INSTRUMENTATION (Open Elective-II)				

Objective To enable the students to understand the principles and to acquire the knowledge on measuring systems, different types of instruments used for measuring the parameters like pressure, force, strain, temperature, sound, acceleration and displacement etc. and also to study practically using instruments for carrying out the experiments related to the concerned fields.

Course Outcome:

1. Explains the measurements for various types of instruments cited
2. Apply the knowledge of transducer in measuring Instruments.
3. Apply the knowledge of various instruments in measuring pressure.
4. Measures the strain and temperature using various instruments.
5. Apply the knowledge of instruments in measuring pressure and sound

Unit- I:

Measurement and its significance, methods of measurement – direct methods and indirect methods and classification of measurements – primary measurements, secondary measurements and tertiary measurements. Instruments and measuring systems, their classification – according to history of instruments, according to mode of measurement and according to the functional requirement and principles of operation. Their principles of operation. Functional elements of a generalized measurement system–basic functional elements – transducer element, signal conditioning element and data precision elements and auxiliary elements. Examples of instruments for identification of basic and auxiliary elements – bourdon tube pressure gauge with out and with electrical read out, spring balance and proving ring etc. Inaccuracy in measurement and it analysis – types of errors or limiting errors – propagation of error or uncertainty.

Unit-II:

Detector transducer elements – introduction, classification and their principles – primary and secondary transducers, mechanical transducer, pressure transducers and active, passive transducers, analogue transducers and digital transducers. Signal conditioning elements and their principles of operation, data presentation elements and types – visual display type, graphical recording type, magnetic type and digital type. Static performance characteristics of instruments: static sensitivity, independent and proportional linearity, hysteresis, threshold, resolution and drift – zero and sensitivity drifts.

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Unit- III:

Measurement of pressure: Introduction, types of pressure – atmospheric pressure, gauge pressure and absolute pressure, units of measurement and conversion of units form one system or another system. Types of pressure measuring devices with examples–mechanical devices, electromechanical devices. Manometers – types: simple U tube manometer. Well type manometer and inclined well manometer – ranges and their application – fluids used in manometer – desirable properties of manometric fluids – micro manometer for measuring very low pressures. Low pressure measurement devices – basic methods of measuring low pressures –study of McLeod pressure gauge used for measuring vacuum pressures: principles, construction, range and limitations. Electrical methods of measuring pressure – pressure sensitivity of resistance gauge – study of Bridgman pressure gauge used for measuring very high pressures: construction, principle, range and applications.

Unit- IV:

Measurement of strain – introduction, strain gauge principle, metals used for manufacturing strain gauges – strain gauge theory and gauge factor. Strain gauge circuits – Wheatstone bridge circuit and unbalanced bridge. Measurement of change of resistance. Cross sensitivity and temperature compensation using dummy gauge and more than one active gauge – advantages and applications of strain gauges.

Strain gauge arrangements – measurement of axial force applied to simple beams by the arrangement of one active gauge, using two active gauges and suing of active gauges. Measurement of force applied to a cantilever by using four active gauges–simple arrangement method and Poisson arrangement method. Measurement of pressure using strain gauges – diaphragm type strain gauge pressure transducer.

Measurement of temperature – introduction and classification of temperature measuring gases along

with examples – bimetallic, mercury and vapor pressure thermometer. Bimetallic thermometers – principles – types: materials of construction – advantages of measurement and applications. Liquid in glass thermometers – type of liquids used – desirable properties of liquids – complete immersion and partial immersion type measurement – ranges – disadvantages. Liquid in metal thermometer. Thermometers based on expansion of gases – vapor pressure thermometer; construction, principles, gases used , range, merits and limitations.

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Unit- IV:

Electrical methods of measuring pressure – electrical resistance thermometers – conductor type and semiconductors type – metals used – platinum resistance thermometer. Thermister – principle – metals used – types based on shape – range of measurement – advantages – limitations. Comparison between thermometer and thermister. Thermometer – principle – thermocouple laws – base metal type and rear metal type thermocouples – thermocouple materials and characteristics. Comparison between resistance thermometer and thermocouple. Thermopile – principle.

Measurement of sound – introduction – noise and loudness, sound pressure level, sound power level, variation of intensity of sound with distance and combination of sounds. Sound measuring system. Microphone

– principle, types: capacitor type, carbon granule type, piezo electrical crystal type and electrodynamics type- fields of application. Study of speed measuring instruments-stroboscope and tachometer-principles-construction- range. Study of proving ring for force measurement and study of linear variable differentiation transformer (LVDT) for displacement measurement-principles and construction.

TEXT BOOKS:

1 Mechanical Measurements, Sirohi RS and Radhakrishna HC 1983, Wiley Eastern Ltd., 4835/24 Ansari Road, New Delhi
2 Instrumentation, Measurement and Analysis Nakra BC and choudhary KK 1987. Tata McGraw Hill publishing co Ltd., 12/ 4 Asaf Ali Road, New Delhi
3 A course in Mechanical Measurements and Instrumentation, Shawhney A K, 1989, Dhanpat Rai and Sons, 1682, NaiSarak, New Delhi.

REFERENCES:

1. Engineering Measurements and Instrumentation, Adams L F,1981, The English Language Book Society and Hodder and Stoughton, London.
2. Mechanical Measurements, Thomas G B and Buck N L,1969, Oxford and IBH Publishing Co. Ltd., 66, Janpath, New Delhi.

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		3	-/-	3
Artificial Intelligence in Agricultural Engineering (Open Elective-II)				

Objects:

This helps the students to write the language programme; deferens reasoning application to robotics and current trends in intelligent system.

Course Outcome:

1. It is use full in language programming and different reasoning
2. It is helpful to the student to learn different algorithms and language programming.
3. Knowledge helpful in interpreting different rules
4. It is helpful in learning & Planning
5. It is helpful to learn about robotics and current trends in intelligent system

UNIT I:

Foundation and history of artificial intelligent, Problems and Techniques, Artificial Intelligence programming languages, Introduction to LISP and to PROLOG. Problem spaces and searches - Blind search strategies, Breadth first and Depth first, Heuristic search techniques Hill climbing.

UNIT II:

Best first-A*algorithm and AO* algorithm Game tree Minimum maximum algorithms, Game playing, Alpha beta pruning, Knowledge representation issues, Predicate logic, Logic programming, Semantic nets, Frames and inheritance, Constraint propagation.

UNIT III:

Representing knowledge using rules, Rules based deduction systems, Reasoning under uncertainty, Review of probability, Baye's probabilistic interferences, Dempster Shafer theory, Heuristic methods.

UNIT IV:

Symbolic reasoning under uncertainty, Statistical reasoning, Fuzzy reasoning. Temporal reasoning, Non monotonic reasoning, Planning and planning in situational calculus, Representation for planning, Partial order planning algorithm, Learning from examples, Discovery as learning, Learning by analogy, Explanation based learning, Neural nets, Genetic algorithms.

UNIT V:

Principles of Natural language processing, Rule based systems architecture, Expert systems, Knowledge acquisition concepts, Artificial Intelligence application to robotics, Current trends in intelligent system.

TEXT BOOKS:

1 Russell, S. and P. Norvig. 1998. Artificial Intelligence: A Modern Approach. Prentice Hall, USA
2 Rich. Elain and Kevin Knight. 1991. Artifical Intelligence. TMH. New Delhi.

REFERENCES:

1. Patrik Henry Winston. 1992. Artificial Intelligence. Norsa Publishing House, New Delhi.

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		3	-/-	3
Photovoltaic Technology and Systems (Open Elective-II)				

Objectives: To enable the students to acquire knowledge on solar photovoltaic system, types of solar cell, solar photovoltaic module, battery classification, types of charge controller, converters and applications of solar photovoltaic system.

Course Outcomes:

1. Explain the photovoltaic technology and various materials used for PV cell.
2. Describe the solar photovoltaic modules in PV technology.
3. Apply the knowledge of various batteries for balance of solar PV system.
4. Adopt the knowledge of converters in various applications of solar PV technology.
5. Apply the knowledge of various characteristics of solar PV system design.

UNIT I:

Solar PV Technology: Advantages, Limitations, Current Status of PV technology, SWOT analysis of PV technology. Types of Solar Cell, Wafer based Silicon Cell, Thin film amorphaous silicon cell Thin Cadmium telluride (CdTe) Cell, Copper Indium Gallium Selenide (CiGS) Cell, Thin film crystalline silicon solar cell.

UNIT II:

Solar Photo Voltaic Module: Solar cell, solar module, solar array, series & parallel connections of cell, mismatch in cell, fill factor, effect of solar radiation and temperature on power output of module, I-V and power curve of module.

UNIT III:

Balance of Solar PV system: Introduction to batteries, battery classification, lead acid battery, Nicked Cadmium battery, comparison of batteries, battery parameters, Charge controller: types of charge controller, function of charge controller, PWM type, MPPT type charge controller.

UNIT IV:

Converters: DC to DC converter and DC to AC type converter. Application of Solar PV system. Solar home lighting system, solar lantern, solar fencing, solar street light, solar water pumping system, Roof top solar photovoltaic power plant and smart grid.

UNIT V:

Study of V-I characteristics of solar PV system, smart grid technology and application, manufacturing technique of solar array, different DC to DC and DC to AC converter, domestic solar lighting system, various solar module technologies, Study of Map, Safe measurement of PV modules electrical characteristics and Commissioning of complete solar PV system.

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TEXT BOOKS:

1. Rai G.D. 1998. Non-conventional Sources of Energy. Khanna Publishers, New Delhi.
2. Rathore N.S., Kurchania A.K., Panwar N.L. 2006. Renewable Energy:Theory & Practice, Himanshu Publications, New Delhi.
3. Solanki C.S. 2011. Solar Photovoltci: Fundamentals, Technologies and Appliations, PH1Learning Private Ltd., New Delhi.

REFERENCES:

1. Meinel & Meinel. 1976. Applied Solar Energy, Addison-Wesley Educational Publishers Inc., USA.
2. Derrick, Francis and Bookalders. 1991. Solar Photo-voltaic Products, ITDG Publishing, UK.

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		3	-/-	3
FOOD PACKAGING TECHNOLOGY (Professional Elective-II)				

Objective:
To provide knowledge on factors influencing spoilage of foods, packaging systes, different packaging materials, packaging equipments and packaging technology.

Course Outcomes:
Gains an insight about need and importance of packing.
Equipped with knowledge on factors influencing foods and foods and food products and packaging laws and regulations for prevention of spoilage of packed foods.
Provided an insight in different packaging material used for packs foods and food products.
Gives information about packing of different foods.
Gets knowledge on container making process for packing food and food products.

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 up gradation – 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, elimatic 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 (P&B) - Narrow Neck Press and Blow (NNPB) - 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 (GTR) - water vapour transmission rate (WVTR).

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 – Ethylenvinyl Alcohol- Polyethylene terephthalate Coating - Laminating - Coating process – Laminating Processes.

TEXT BOOKS:

4. Food Packing Technology by Richard Coles and Mark J. Kirwan, Wiley Blackwell Publishing. 2nd

Edition. 2011

5. In – Pack Processed Food by P. Richardson, Woolhead Publishing, 1st Edition, 2008.
6. Food Packaging Principles and Practices by Gordon L. Robertson, CRC Press, 3rd Edition, 2013.

REFERENCES:

3. Recent Innovation in Barrier Technology for Plastic packaging , A review by Jacob L. Packaging Technology and Sciences, 2003.
4. New Concept in Dairy Packaging byVarghes S. and Goyal G.K , Beverages and Food world.

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		3	-/-	3
WATERSHED MANAGEMENT (Professional Elective-II)				

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.

Course Outcomes:

1. Skill development on basic principles of water development and various steps involved.
2. Skill acquiring on principles, concepts of watershed management, watershed planning, codification, priorization of watersheds, sediment yield indese and water budgeting.
3. Skills development on rain water conservation technologies, their concepts, principles for planning and design, Dryland techniques, integrated watershed management for arable, suni arid and with agriculture & horticulture, non arable technologies with fureshy, fishery and animal husbandry.
4. Skills development on watershed cropping systems & their diversification, its effects on hydrology suspense's, programme execution, monitoring & evaluation & watersheds.
5. Skills development in participatory watershed development and management, farmer institutions, formulation of watershed projects, socio economics.

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 ec-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.

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		3	-/-	3

HUMAN ENGINEERING AND SAFETY
(Professional Elective-III)

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 & trailer operator.

Outcomes:
Gets information on relationship among human, environment and machine factors for human safety.
Gives knowledge on functions of skeletal and muscular systems for human body equilibrium.
Gets information on biometric tools for handling physical works.
Enables knowledge on factors influencing physical work capacity for human safety.
Gives an insight on development of agricultural tools which reduces sound and air pollution.

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_2 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.

Text Books:

1. Work study and Ergonomics, Dalela S and Saurabh 1995, Standard Publishers and Distributors, NewDelhi.
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., NewDelhi.

Reference books:

1. Human Factors in Engineering and Design, Sanders M S and McCormick E J 1992. McGraw-Hill Book Co., NewDelhi.
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).

IV Year B.Tech. Ag. Engg I Sem.		L	T/P	C
		3	-/-	3
GIS AND REMOTE SENSING (Professional Elective-III)				

Objective:

To equip the students with the knowledge on techniques of Remote Sensing and GIS applications for land and water resources management with projections on yield response to irrigation water, mapping of salt affected and waterlogged lands and techniques of image processing for various applications in efficient natural resources management.

Course Outcome:

1. Student will learn about the remote sensing date data acquisition and analysis also the impartment of IRS Satellites
2. Student will know about image interpretation visuals
3. Student will learn the digital image processing
4. Student learn the application of RS in agricultural, geology and soil mapping

Student will learn the data base management system using various GIS package

UNIT-I

Remote sensing: Introduction to Remote Sensing, types of remote sensing, Data acquisition and analysis, Sensors- Remote sensing sensors and applications, important features of Indian Remote Sensing Satellites, **Electromagnetic spectrum**: Different bands, Resolution, Spectral response Pattern-multi spectral data use, modern remote sensing technology versus conventional aerial photography.

UNIT – II

Visual image interpretation: Image interpretation, Basic principles of image interpretation and techniques, Factors governing the quality of an image, Factors governing interpretability, visibility of objects, Elements of image interpretation.

Unit III

Digital image processing- Digital image, pixel, resolution, Image processing overview; Image restoration- Radiometric correction-DN (Digital Number value) – Noise removal and correction, Atmospheric error and correction, Geometric Error and correction. **Image enhancement** -Contrast manipulation-gray level thresholding-level slicing-contrast stretching, Digital image processing-spatial Feature Manipulation-spatial filtering- convolution edge enhancement.

Vegetation Indices: Digital image processing, vegetation components, supervised and unsupervised image classification and output stage data merging,

Unit – IV

Remote sensing in agriculture: Progress and prospects of yield assessment, remote sensing application in water resources development, remote sensing in soil conservation, aerial photo interpretation for water resources development and soil conservation survey. Remote sensing in geology and soil mapping.

Unit – V

Geographical Information System: History & development of GIS: Definition, Basic components and standard GIS packages. Date entry, storage and maintenance, Data types – spatial, non-spatial (attribute-date), Data structure, data format, point line vector-raster polygon, Object structural model, files, files organization, Data base management, systems (DBMS), Entering data in computer-digitizer-scanner data compression.

TEXT BOOKS:

1. Remote sensing and Geographical information system, BS publications, sultan Bazaar, Hyderabad – 3
2. Introduction to Remote sensing, James B and Compell, Published by Taylor & Francis Limited.

REFERENCES:

1. Basics of remote Sensing and GIS, University Science Persons.
2. Remote Sensing and GIS by Basudeb Bhatta, Oxford University Persons, New Delhi.

IV Year B.Tech. Ag. Engg I Sem.		L	T/P	C
		3	-/-	3
PRODUCTION TECHNOLOGY OF AGRICULTURAL MACHINERY (Professional Elective-III)				

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.

Course Outcome:

1. Explain the essential elements, components and forces among them in designing of agricultural machinery.
2. Explain the various tools and componential turning centers in machinery
3. Use the power metallurgy characteristics, preparation and process to design the elements in machinery.
4. Design the jigs, fixtures and machine control tools

Apply the knowledge of control units using the programming skills.

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, drilling tools, 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 anis machining centers – twin turret tuning centre. CNC Turning centers – Multiple spindle 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 & tolerances – limits and fits compound tolerances – conditions for the success of any system of limits & fits, Terms & definitions.

Unit-IV:

Jigs & fixtures – Jigs, fixtures, differences between jigs & fixtures – advantages of jigs & fixtures – essential features of jigs & fixtures. General rules for designing jigs & fixtures – Different types of jigs – Types of fixtures. Controllers – CNC controlling for machine tools – motion control systems – Point to 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 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.

Reference:

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

IV Year B.Tech. Ag. Engg I Sem.		L	T/P	C
		3	-/-	3
FOOD PLANT DESIGN AND MANAGEMENT (Professional Elective-III)				

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.

Course Outcomes:

Gets trained in organization of food and agricultural processing machinery as per process flow.

Will have knowledge on types and salient features of different plant layouts such as rice, maize, horticultural pulses, oil seeds, milk and milk products, poultry, meat & fish.

Will have an understanding of site selection, layout procedures and project design concepts and considerations.

Gets knowledge on principles and types, requirements of food processing industries includingmachinery etc,.

Will learn te environmental protection from food plant sanitation and economic sepects, record |& report maintenance of food plants.

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 – sailent 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 equipments - 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 equipments - 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 and repairs, common denominator, plant installation, power and power transmission - systems.

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 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 repots, organization of reports, organization of a design report, preparing the report, rhetoric, checklist for the final report.

TEXT BOOK:

Dairy and Food Engineering, Farall F W 1992. John Wiley & Sons, New York.

REFERENCES:

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.
4. Food Technology Processing and Aylward F 2001. Allied Scientific Publishers, Bikaner. Laboratory Control.

IV Year B.Tech. Ag. Engg I Sem.		L	T/P	C
		0	0/3	1.5
FARM MACHINERY LAB II				

Objects:

To enable the students to know the development of different agricultural machinery and tools for production and pre harvesting of different crops.

Course Outcomes:

1. Student will have knowledge on requirement of different materials and parts for development of farm machinery and tools.
2. Yets practical knowledge on development of farm machinery for production and pre har veeting of various crops.
3. Students gets knowledge on safely rules in operating farm implements based on IS standards

Practical

1. To study the various types of mowers, constructional details, materials and working.
2. To practice the alignment and registration of mower.
3. To study the various types of reaper, constructional details, materials used, working and performance
4. To measure the different losses in thresher and threshing efficiency of a thresher.
5. To study about the various types of chaff cutters and their capacity.
6. To study about constructional details, materials used and working of potato harvesters.
7. To study about constructional details, materials used and working of groundnut harvesters
8. To study the various types of cotton strippers, constructional details, materials used and working
9. To study about safety rules for operating the harvesters, threshers and combiners based on IS standards.
10. To study about different horticultural tools.
11. To visit the machinery production industry and ICAR SAU'S Research Station.

REFERENCE BOOKS:

1. Farm Machinery, Stone A A 1958. John wiley and sons, NewYork.
2. Farm Machinery and Equipment. Smith H.P. 1971. TataMcGraw-HillsPublishing Co., Ltd., NewDelhi.
3. Testing and Evaluation of Agricultural Machinery. Mehta M.L., Verma S.R.MisraS.K. and Sharma

V.K. Daya Publishing House, New Delhi.

4. Farm Machinery and Equipment, Smith H P 1971. Tata McGraw HillPublishing Co. Ltd., New Delhi

IV Year B.Tech. Ag. Engg I Sem.		L	T/P	C
		0	0/2	1
SUMMER IN-PLANT TRAINNING/INTERNSHIP (After 6th Semester) for four weeks				

IV Year B.Tech. Ag. Engg I Sem.		L	T/P	C
		0	0/3	1.5
RESEARCH PROJECT – PART -I				