

Study Scheme & Syllabus of **Bachelor of Technology** **(Agriculture Engineering)**

Batch 2019 onwards



By

Department of Academics
IK Gujral Punjab Technical University

SEMESTER 3 rd		Contact Hrs.			Marks			Credits
Subject Code	Subject Name	L	T	P	Int.	Ext.	Total	
BTAG301-19	Agriculture for Engineers	3	1	0	40	60	100	4
BTAG302-19	Farm Machinery	3	1	0	40	60	100	4
BTAG303-19	Thermodynamics and Heat Engine	3	1	0	40	60	100	4
BTAG304-19	Wasteland Development	3	1	0	40	60	100	4
BTAG305-19	Irrigation Engineering	3	1	0	40	60	100	4
BTAG306-19	Agriculture for Engineers Lab	0	0	2	60	40	100	1
BTAG307-19	Farm Machinery Lab	0	0	2	60	40	100	1
BTHU301-19	Soft Skills-I	0	0	2	60	40	100	1
BTAG308-19	Institutional Training*	0	0	4	60	40	100	2
BMPD301-19	Mentoring and Professional Development	0	0	2	Satisfactory / Un-Satisfactory			Non-Credit
Total		15	5	12	440	460	900	25

* Institutional Training after 2nd semester during summer vacations

AGRICULTURE FOR ENGINEERS

Subject Code: BTAG301-19

Unit - I

Soil Characteristics: Nature and origin of soil, Soil forming rocks and minerals, their classification and composition, Soil forming processes, Classification of soils, Soil taxonomy orders, Important soil physical properties and their importance, Soil particle distribution, Soil inorganic colloids – their composition, Ion exchange in soil and nutrient availability.

Unit – II

Soil Organic Matter: Its composition and decomposition, effect on soil fertility, saline and sodic soils Quality or irrigation water, Essential plants nutrients, Functions and deficiency symptoms in plants, Important inorganic fertilizers and their reactions in soils. Soil water plant relationship, Crop rotation, cropping systems, Mixed cropping, Relay cropping

Unit - III

Agronomy: Definition and scope of agronomy, Classification of crops, Effect of different weather parameters on crop growth and development, Principles of tillage, Tillage and its characteristics,

Horticulture: Scope of horticultural and vegetable crops, Soil and climatic requirements for fruits Soil and climatic requirements for Vegetables, improved varieties of horticulture crops High-tech horticulture- Poly-houses for flowers and vegetables.

Unit –IV

Criteria for Site Selection of Horticulture Crops: Layout and planting methods, Nursery raising, Macro and micro propagation methods, Pant growing structures, Pruning & training, Fertilizer application process, Fertigation, Harvesting, Grading and packaging, Post-harvest practices, Garden tools, management of orchard, Extraction and storage of vegetables seeds.

Recommended Books:

1. T.D. Biswas and S.K. Mukherjee, 'Soil Science', TMH Publication.
2. T. Yellamanda and G.H. Sankara Reddy, 'Principle of Agronomy', Kalyani Publication.
3. Jitendra Singh, 'Basic Horticulture', Kalyani Publisher.
4. K.K. Mehta, 'Reclamation of Alkali Soil in India', Oxford & IBH.
5. Maharaj Singh, 'Education for Sustainable Agriculture', Indian J. Agronomy.

FARM MACHINERY

Subject Code: BTAG302-19

Unit – I

Tillage: primary and secondary tillage equipment, Zero and conservation tillage equipment Forces acting on tillage tools, Hitching systems and controls, Measurement of forces of tillage tools, Draft measurement of tillage equipment, Types of dynamometer; spring type, Hydraulic type and strain gauge types.

Unit – II

Objectives of Farm Mechanization: Classification of farm machines, Materials of construction and heat treatment, Principles of operation and selection of machines used for production of crops, field capacities and economics.

Unit – III

Earth Moving Equipment: Their construction & working principles, Bulldozer, Elevators, Scraper and Digger, Sowing, planting & transplanting equipment, various type Zero till ferti-drill Seed and planting metering devices, their calibration and adjustments. Furrow openers and covering devices, Fertilizer application equipment and their metering devices.

Unit – IV

Weed control and Plant protection equipment- sprayers and dusters, their calibration selection, constructional features of different components, harvesting machinery- mowers, windrowers, reapers, reaper binders and forage harvesters, forage chopping & handling equipment, Description working principle of threshing machineries, grain and straw combine.

Recommended Books:

1. R.A. Kepner, Roy Bainer, 'Principles of Farm Machinery,' CBS Publication.
2. Radhey Lal, 'Agricultural Engineering', Saroj Publication.
3. Jagdishwar Sahay, 'Elements of Agricultural Engineering', Standard Publishers Distributors.
4. R. Suresh, 'Farm Power and Machinery Engineering', Standard Publishers Distributors.
5. Triveni Singh Prasad, 'Farm Machinery,' PHI, 2016.

THERMODYNAMICS AND HEAT ENGINE

Subject Code: BTAG303-19

Unit – I

Thermodynamics Properties: Closed and open system Flow and non-flow processes Gas laws of thermodynamics Internal Energy Application of first law in heating and expansion of gases in non-flow processes First law applied to steady flow processes.

Unit – II

Second Law of Thermodynamics: Kelvin-Planck statement, Clausius Statement, Reversible processes, Carnot cycle, Carnot theorem, Steam Generator- Classification of steam boilers, Lancashire boiler, Locomotive boiler, Boiler mountings, Boiler accessories, Desirable properties of working fluid used for power plants, Rankine cycle

Unit – III

Entropy: Physical concept of entropy, Change of entropy of gases at constant volume, Change of entropy of gases at constant Pressure, Change of entropy of gases at constant Temperature, Change of entropy of gases at reversible adiabatic process Change of entropy of gases at poly tropic process.

Unit – IV

Thermodynamic Air Cycle: Air Standard efficiency, Engine efficiencies and terms, Otto cycle, Diesel cycle, Dual cycle, mean effective pressure, Measurement of IP and BP, HBC.

Recommended Books

1. D.S. Kumar, 'Thermodynamics', Katson Publication 1st Edition, **2009**.
2. D.K. Jha, 'A Text Book of Thermodynamics', Discovery Publishing House.
3. R.S. Khurmi & J.K. Gupta, 'A Text Book of Thermal Engineering,' S. Chand & Company Limited, reprint **2002**.
4. P.K. Nag, 'Engineering Thermodynamics', TMH Publication.
5. R. Yadav, 'Thermodynamics and Heat Engines', Central Publishing House, **2002**.

WASTELAND DEVELOPMENT

Subject Code: BTAG304-19

Unit – I

Land Degradation: Concept, classification - arid, semiarid, humid and sub-humid regions, denuded range land and marginal land, Wastelands - factors causing, classification and mapping of wastelands, planning of wastelands development - constraints, agro-climatic conditions, development options, contingency plans.

Unit – II

Conservation Structures: Gully stabilization, ravine rehabilitation, sand dune stabilization, water harvesting and recycling methods (In brief). **Afforestation**-Agro-horti-forestry Silvopasture methods forage and fuel crops– socioeconomic constraints, Shifting cultivation, optimal land use options.

Unit – III

Wasteland Development: Hills, semi-arid, coastal areas, water scarce areas, reclamation of waterlogged and salt-affected lands. Mine spoils- impact, land degradation and reclamation and rehabilitation, slope stabilization and mine environment management.

Unit-IV

Micro-irrigation- Use in wastelands development, Sustainable wasteland development- drought situations, socio-economic perspectives. Government policies, Participatory approach. Preparation of proposal for wasteland development and benefit-cost analysis.

Recommended Books

1. I.P. Abrol and V.V. Dhruva Narayana, 'Technologies for Wasteland Development,' ICAR, New Delhi, 1998.
2. S.K. Ambast, S.K. Gupta and Gurbachan Singh, 'Agricultural Land Drainage – Reclamation of Waterlogged Saline Lands'.
3. H.R. Yadav, 'Management of Wastelands', Concept Publishing Company, New Delhi.
4. S.C. Kalwar, 'Wastelands and Planning for Development', Concept Publishing Company 2008.
5. C. Karthikeyan, K. Thangaraja, C. Cinthia Fernandez and K. Chandrakandon, 'Dryland Agriculture and Wasteland Management', Atlantic Publishers, New Delhi, 2009.

IRRIGATION ENGINEERING

Subject Code: BTAG305-19

Unit- I

Source of irrigation water, measurement of irrigation water, infiltration, application of soil plant atmospheric continuum and principles of fluid mechanics to design of irrigation system, water balance equation and evaluation of different components; measurement of evaporation and evapo-transpiration.

Unit- II

Water resource development and utilization in India, Surface water resources ground water resources, India's water budget, utilization of water resources, factors a fleeting water utilization, major river basins of India

Unit- III

History and development of Irrigation in India, Classification of irrigation projects, canal network, water distribution pattern, system of levying irrigation charges.

Unit- IV

Estimation of irrigation water requirement and irrigation scheduling: efficiencies of irrigation systems, Hydraulics, Design and evaluation of surface, sub-surface, overhead and drip irrigation systems; design of water conveyance systems including control structures, design principles, Selection of pumps and prime movers.

Recommended Books:

1. A.M. Michael, 'Irrigation Theory and Practice', Vikas Publications, New Delhi.
2. S.K. Majumdar, 'Irrigation Engineering', Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1983.
3. Om Prakash, 'Irrigation and Water Management', Rama Publishing House, Meerut.
4. K.K. Schwab, 'Soil and Water Conservation Engg.' John Wiley and Sons Inc. New York.
5. R. Lal 'Irrigation Hydraulics', Saroj Prakashan, Allahabad, 1978.
6. N.N. Basak, 'Irrigation Engineering', McGraw Hill Education, 1999.

EXPERIMENTS

1. Study of Garden tools, implements and plant protection equipment.
2. Identification of rocks and minerals.
3. Study of manures and fertilizers.
4. Study of layout in different irrigation systems.
5. To study of Pruning and training of orchard trees.
6. Examination of soil profile in the field.
7. Determination of bulk density.
8. Identification of weeds.
9. Determination particle density and porosity of soil.
10. Study of different Cultivator.
11. Study of different weed control methods.
12. Determination of organic carbon of soil.
13. Fertilizer application methods.
14. Study of different orchard layout methods.
15. Identification of crops and their varieties seeds.

FARM MACHINERY LAB.

Subject Code: BTAG307-19

EXPERIMENTS

1. To study animal drawn and tractor drawn mould Board ploughs.
2. Introduction to various farm machineries.
3. To study Indigenous or country plough.
4. To study the starting and stopping of Diesel Engine.
5. Introduction, construction and working of earth moving equipment.
6. To study four stroke cycle engine.
7. Construction and working of rotavator and other rotary tillers.
8. To study cultivators and its important functions.
9. Weeding equipment- their use and adjustment
10. Field operation of sowing and planting equipment and their adjustments.
11. Field capacity and field efficiency measurement for at least two machines/implements.
12. Working of Paddy Transplanter and their calibration.
13. To Study the field capacity of sprayer and duster.
14. To study Air cooling system and its advantages.
15. Study on methods of repair, maintenance and off season storage of farm equipment.
16. Working of seed-cum-fertilizer drills and their calibration.

SOFT SKILLS-I

Subject Code: BTHU301-19

UNIT-1

Soft Skill: Introduction to Soft Skills, Aspects of Soft Skills, Identifying your Soft Skills, Negotiation skills, Importance of Soft Skills, Concept of effective communication.

Self-Discovery: Self-Assessment, Process, Identifying strengths and limitations, SWOT Analysis Grid.

UNIT-2

Forming Values: Values and Attitudes, Importance of Values, Self-Discipline, Personal Values - Cultural Values-Social Values-some examples, Recognition of one's own limits and deficiencies.

UNIT-3

Art of Listening: Proxemics, Haptics: The Language of Touch, Meta Communication, Listening Skills, Types of Listening, Listening tips.

UNIT-4

Etiquette and Manners: ETIQUETTE- Introduction, Modern Etiquette, Benefits of Etiquette, Taboo topics, Do's and Don'ts for Men and Women. MANNERS- Introduction, Importance of manners at various occasions, Professional manners, Mobile manners. CORPORATE GROOMING TIPS- Dressing for Office: Do's and Don'ts for Men and Women, Annoying Office Habits.

Recommended Books:

1. K. Alex, S. Chand Publishers.
2. Butterfield, Jeff, 'Soft Skills for Everyone', Cengage Learning, New Delhi, 2010.
3. G.S. Chauhan and Sangeeta Sharma, 'Soft Skills', Wiley, New Delhi, 2016.
4. Klaus, Peggy, Jane Rohman & Molly Hamaker, 'The Hard Truth About Soft Skills', Harper Collins E-books, London, 2007.
5. S.J. Petes, Francis, 'Soft Skills and Professional Communication', Tata McGraw Hill Education, New Delhi, 2011.

SEMESTER 4 th		Contact Hrs.			Marks			Credits
Subject Code	Subject Name	L	T	P	Int.	Ext.	Total	
BTAG401-19	Surveying and Levelling	3	1	0	40	60	100	4
BTAG402-19	Theory of Machines	3	1	0	40	60	100	4
BTAG403-19	Engineering Economics	4	0	0	40	60	100	4
BTAG404-19	Soil & Water Conservation	3	0	0	40	60	100	3
BTAG405-19	Farm Power	3	1	0	40	60	100	4
BTAG406-19	Surveying and Levelling Lab.	0	0	2	60	40	100	1
BTAG407-19	Theory of Machines Lab.	0	0	2	60	40	100	1
BTAG408-19	Soil & Water Conservation	0	0	2	60	40	100	1
BTHU401-19	Soft Skills-II	0	0	2	60	40	100	1
EVS101-18	Environmental Studies	2	0	0	50	00	50	Non-Credit
BMPD401-19	Mentoring and Professional Development	0	0	2	Satisfactory / Un-Satisfactory			Non-Credit
Total		18	3	10	490	460	950	23

SEMESTER 5 TH		Contact Hrs.			Marks			Credits
Subject Code	Subject Name	L	T	P	Int.	Ext.	Total	
BTAG501-19	Agricultural Structure and Environmental Control	3	0	0	40	60	100	3
BTAG502-19	Soil and Water Conservation Structures	3	1	0	40	60	100	4
BTAG503-19	Dairy and Food Engineering	2	1	0	40	60	100	3
BTAG504-19	Tractor System, Controls & Operation	3	1	0	40	60	100	4
BTAG505-19	Principles of Plant Protection	2	0	0	40	60	100	2
BTAG506-19	Protected Cultivation and Post Harvest Technology	1	0	0	60	40	100	1
BTAG507-19	Soil and Water Conservation Structures Lab.	0	0	2	60	40	100	1
BTAG508-19	Tractor System, Controls & Operation Lab.	0	0	2	60	40	100	1
BTAG509-19	Dairy and Food Engineering Lab.	0	0	2	60	40	100	1
BTAG510-19	Principles of Plant Protection Lab.	0	0	2	60	40	100	1
BTAG511-19	Protected Cultivation and Post-Harvest Technology Lab.	0	0	2	60	40	100	1
BTAG512-19	Training-II*	0	0	4	60	40	100	2
BTHU501-19	Soft Skills-III	0	0	2	60	40	100	1
BMPD501-19	Mentoring and Professional Development	0	0	2	Satisfactory / Un-Satisfactory			Non-Credit
Total		14	3	18	680	620	1300	25

***4 weeks training after 4th semester during summer vacations**

SURVEYING AND LEVELLING

Subject Code: BTAG401-19

Unit – I

Surveying: Principle and basic concepts of surveying, Plans and maps, Classification of surveying, basic measurements, Units of measurement, Types of Scales, Recording the measurement, Principal of chain surveying, Types of Chains, Types of Ranging Chaining Chain and tape errors and corrections, Selection of survey station and lines, offset measurement, Obstacles in chaining and ranging.

Unit – II

Traversing: Methods of traversing, Prismatic compass, Surveyors compass Angle and bearing, quadrantal system, Local attraction, Dip of angle, magnetic declination, Plotting a traverse survey, Errors in compass survey, Bow ditch's rule, Transit rule.

Unit – III

Plane Tabling: Plane tabling instruments and accessories, Methods and principal, two points problem, three points problem, Errors in plane tabling,

Theodolite: Theodolite traversing, Theodolite Surveying, Ranging by theodolite, Temporary and Permanent adjustment of theodolite.

Unit – IV

Levelling: Definition, Basic principal of levelling, Benchmark, Types of levels optical, Principal causes telescopes sensitivity of bubble tubes, levelling staff, Temporary adjustment, Permanent adjustment of levels, Field book entries, types of levelling, Simple and differential levelling, Check levelling & reciprocal levelling, Precise levelling, profile levelling.

Recommended Books:

1. B.C. Punamia, 'Surveying and Levelling', Vol-I & Vol-II, Laxmi Publications, **2005**.
 2. Kanetkar & Kulkarni, 'Surveying and Levelling Part-1', Vidyarthi Griha Prakashan, Pune.
 3. S.K. Duggal, 'Surveying', Vol I & II, Tata McGraw Hill, **2006**.
 4. R. Agor, 'Surveying', Khanna Publishers.
 5. S.S. Bhavikatti, 'Surveying & Levelling', Vol. I & II, **2009**.
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THEORY OF MACHINES

Subject Code: BTAG402-19

Unit – I

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, Degree of freedom, Determination of velocity and acceleration using graphical (relative velocity and acceleration) method. Instantaneous centres.

Unit – II

Cam, Types of cam, Terminology used in cam-follower system, Cam profile, Gear train, Simple, compound, reverted, and epicyclical gear trains, Determination of velocity ratio and train value by tabular method.

Unit – III

Introduction to 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.

Unit – IV

Introduction to Clutches, Types of clutches (Single disc, multiple disc, and cone clutches). Balancing of rotating masses in one and different planes,
Governor: Introduction, Types, Constructional details and Analysis of Watt, Porter, Proell governor, Sensitiveness, stability, hunting, isochronisms, power and effort of a governor, flywheel.

Recommended Books:

1. R.S. Khurmi, 'Theory of Machines', S. Chand Publication.
 2. S.S. Rattan, 'Theory of Machines', 4th Edn., McGraw Hill Education Publication.
 3. Jagdish Lal, 'Theory of Mechanisms & Machines', Metropolitan Book Co.
 4. V.P. Singh, 'Theory of Machines', Dhanpat Rai Pub.
 5. Thomas Beven, 'Theory of Machines', Longman's Green & Co., London.
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Subject Code: BTAG403-19

Unit – I

Economics: Definitions, Nature and Scope of economics, Difference between Microeconomics and Macro- economics, theory of demand & supply; meaning and determinants of demand, law of demand, law of supply Equilibrium between demand and supply elasticity, price elasticity, income elasticity of price, income and cross elasticity.

Unit – II

Theory of Production: Production function, meaning, factors of production (meaning & characteristics of Land, Labour, capital & entrepreneur), Law of variable proportions & returns to scale Cost; meaning of short run & long run cost, fixed cost, variable cost, total cost, average cost, marginal cost, opportunity cost. Break even analysis; meaning, explanation, numerical.

Unit – III

Markets: Meaning, types of markets & their characteristics (Perfect Competition, Monopoly, Monopolistic Competition, Oligopoly). **National Income-** meaning, stock and flow concept, NI at current price, NI at constant price, GNP, GDP, NNP, NDP, Personal income, disposal income.

Unit –IV

Unemployment: Meaning, types, causes, remedies, Inflation- meaning, types, causes, measures to control, Money- meaning, functions, types, Monetary policy and Fiscal policy - meaning, objectives and tools. Human Resource Management- Definitions, objectives of manpower planning, process, sources of recruitment, process of selection.

Recommended Books:

1. R. Paneerselvam, 'Engineering Economics', PHI.
 2. N. Gregory Mankiw, 'Principles of Economics', Cengage Learning.
 3. K.K. Dewett & M.H. Navalur, 'Modern Economic Theory', S. Chand Publications.
 4. Vaish and Sundharam, 'Principles of Economics', Ratan Prakashan Mandir, Agara.
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SOIL AND WATER CONSERVATION

Subject Code: BTAG404-19

Unit – I

Introduction: Soil erosion - causes, types and agents of soil erosion; water erosion – forms of water erosion, mechanics of erosion; gullies and their classification, stages of gully development; characteristics of contours and preparation of contour maps.

Unit – II

Erosion Control Measures: Agronomical measures - contour cropping, strip cropping, mulching; mechanical measures - terraces – level and graded broad base terraces and their design, bench terraces & their design, layout procedure, terrace planning, bunds - contour bunds, graded bunds and their design; gully and ravine reclamation.

Unit – III

Wind Erosion: Factors affecting wind erosion, mechanics of wind erosion, soil loss estimation, wind erosion control measures - vegetative, mechanical measures, wind breaks and shelter belts, sand dunes stabilization.

Unit – IV

Soil Loss Estimation: Universal soil loss equation and modified soil loss equation, determination of their various parameters, Sedimentation - sedimentation in reservoirs and streams, estimation and measurement, sediment delivery ratio, trap efficiency.

Design Principle of Channel: Most Economical trapezoidal, introduction to water harvesting techniques; introduction to stream water quality and pollution.

Recommended Books:

1. Michael, 'Principles of Agricultural Engineering', Vol.-2, Jain Brothers, 2013.
 2. R. Suresh, 'Soil & Water Conservation Engineering', Standard Publishers Distributors.
 3. Ghanshyam Das, 'Hydrology and Soil Conservation Engineering: Including Watershed Management', 2nd Edn., PHI Publication, 2009.
 4. V.V.N. Murthy, 'Land and Water Management Engineering', Kalyani Publishers, 2013.
 5. R.P. Tripathi and H.P. Singh, 'Soil Erosion and Conservation', 1st Edn., New Age Publishers, 1993.
 6. Bimal Chandra Mal, 'Introduction to Soil and Water Conservation Engineering', Kalyani Publishers, 2011.
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FARM POWER

Subject Code: BTAG405-19

Unit – I

Sources of farm power - conventional & non-conventional energy sources and their utilization, classification of tractors and IC engines, Review of thermodynamic principles of IC (CI &SI) engine and deviation from ideal cycle.

Unit – II

Engine & their components, their construction, operating principles and functions, valves and valve mechanism, Firing order and diagram, criteria for selection. Study of constructional details, adjustments and operating principles of fuel and air supply, cooling, lubricating, ignition, governing and electrical systems.

Unit – III

IC engine fuels - their properties & combustion of fuels, gasoline tests and their significance, diesel fuel tests and their significance, detonation and knocking in IC engines, Properties of coolants, anti-freeze and anti-corrosion materials, lubricant types & study of their properties.

Unit – IV

Transmission systems of wheel and track type tractors: clutch, gear box, differential and final Drive mechanism PTO system, type, standardization, belt and pulley on tractor and their standardization. Preventive maintenance of various systems.

Recommended Books:

1. Jagdishwar Sahay, 'Elements of Agricultural Engineering', St. Publishers Distributors.
 2. John B. Lijiedahal, Paul K. Turn quist, 'Tractors and their Power Units', CBS Publication.
 3. S.C. Jain, 'Farm Tractor maintenance and repair,' Standard Publishers Distributors.
 4. Donnell Hunt, 'Farm Power and Machinery Management', Medtech, 10th Edn., 2013.
 5. Suresh, 'Farm Power and Machinery Engineering', Standard Publishers Distributors.
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SURVEYING & LEVELLING LAB.

Subject Code: BTAG406-19

EXPERIMENTS

1. Chain survey of an area and preparation of map
 2. Measurement of distance, ranging a line.
 3. Compass survey of an area and plotting of compass survey.
 4. Contour survey of an area and preparation of contour map.
 5. Introduction of software in drawing contour.
 6. Plane table survey, different methods of plotting, two point & three-point problem.
 7. Measurement of bearing and angles with compass, adjustment of traverse by graphical method.
 8. To study of different methods of levelling, height of instrument, rise & fall methods.
 9. Advancement of Total stations.
 10. Measurement of horizontal and vertical angle by theodolite.
 11. Determination of height of an inaccessible object.
 12. Determination of area of irregular figure by using planimeter.
 13. Height of object by using theodolite.
 14. Setting out of circular curves in the field using different methods.
 15. Determination of tachometric constants and determination of reduced levels by tachometric observations.
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THEORY OF MACHINE LAB.

Subject Code: BTAG407-19

EXPERIMENTS

1. To study the various inversions of kinematic chains.
 2. Conduct experiments on various types of governors.
 3. Demonstration of static and dynamic balancing in the laboratory.
 4. Determination of gyroscopic couple (graphical method).
 5. Balancing of rotating masses (graphical method).
 6. Cam profile analysis (graphical method)
 7. Motion analysis of Epicyclical gear trains using tabular and formula methods.
 8. Analysis of 4-bar mechanism slides crank mechanism and their inversions.
 9. Draw graphs between height and equilibrium speed of a governor.
 10. To draw circumferential and axial pressure profile in a full journal bearing.
 11. To determine coefficient of friction for a belt-pulley material combination.
 12. Determination of moment of inertia of flywheel.
 13. To study the flywheel and governor action in laboratory.
 14. To study the static and dynamic balancing using rigid blocks
 15. To draw displacement, velocity & acceleration diagram of four bar mechanism.
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SOIL AND WATER CONSERVATION LAB.

Subject Code: BTAG408-19

EXPERIMENTS

1. Study of different types of conservation measures.
 2. Design of drop spillway.
 3. Design of drop inlet spillway.
 4. Design of farm pond.
 5. Demonstration of Bench Terrace in the farming.
 6. Study of USLE/MUSLE parameter.
 7. Study about the Contour farming.
 8. Determination from nutrient availability in soil.
 9. To demonstrate the conservation of tillage.
 10. Study of erosion checked by row cropping pattern.
 11. Study of contour cropping effect on soil erosion.
 12. Study of bund /graded/contour bund.
 13. Design of grassed water ways.
 14. Computation of soil erosion by USLE/MUSLE.
 15. Design of Trapezoidal water ways.
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SOFT SKILLS-II

Subject Code: BTHU401-19

UNIT-1

Developing Positive Attitude: Introduction. Formation of attitude. Attitude in workplace. Power of positive attitude. Examples of positive attitudes. Negative attitudes. Examples of negative attitude. overcoming negative attitude and its consequences.

Improving Perception: Introduction. Understanding perception. perception and its application in organizations.

UNIT-2

Career Planning: Introduction. Tips for successful career planning. Goal setting-immediate, short term and long term. Strategies to achieve goals. Myths about choosing career.

UNIT-3

Art of Reading: Introduction. Benefits of reading. Tips for effective reading. the SQ3R technique. Different stages of reading. determining reading rate of students. Activities to increase the reading rate. Problems faced. Becoming an effective reader.

UNIT-4

Stress Management: Introduction. meaning. positive and negative stress. Sources of stress. Case studies. signs of stress. Stress management tips. Teenage stress.

Recommended Books:

1. K. Alex, S. Chand Publishers.
 2. Rizvi, M. Ashraf, 'Effective Technical Communication', McGraw Hill.
 3. Mohan Krishna & Meera Banerji, 'Developing Communication Skills', Macmillan.
 4. Kamin, Maxine, 'Soft Skills Revolution: A Guide for Connecting with Compassion for Trainers, Teams & Leaders', Pfeiffer & Amp; Company, Washington, DC, 2013.
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ENVIRONMENTAL STUDIES

Subject Code: EVS101-18

MENTORING AND PROFESSIONAL DEVELOPMENT

Subject Code: BMPD401-19

Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities. For achieving the above, suggestive list of activities to be conducted are:

Part – A (Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B (Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

AGRICULTURAL STRUCTURE AND ENVIRONMENTAL CONTROL

Subject Code: BTAG501-19

Course Objectives:

To provide the technical knowledge of structures on the farm and to expose the basic concepts of design.

Unit - I

Planning and layout of farmstead, Physiological reactions of livestock to solar radiation and other environmental factors, Livestock production facilities, BIS, Standards for dairy, piggery, poultry and other farm structures.

Unit - II

Design, construction and cost estimation of farm structures; animal shelters, compost pit, fodder silo, fencing and implement sheds, barn for cows, buffalo, poultry, etc.:: Design and construction of rural grain storage system, Engineering for rural living and development, rural roads, their construction cost and repair and maintenance.

Unit - III

Sources of water supply, Norms of water supply for human being and animals, drinking water standards and water treatment suitable to rural community, Site and orientation of building in regard to sanitation, community sanitation system; sewage system its design, cost and maintenance, design of septic tank for small family.

Unit - IV

Estimation of power requirement for domestic and irrigation, source of power supply, use of alternate source of energy, electrification of rural Housing, Scope, importance and need for environmental control, Renewable and non-renewable resources and their equitable use, concept of eco system, biodiversity of its conservation, environmental pollution and their control, solid waste management system, BOD and COD of food plant waste, primary and secondary treatment of food plant waste.

Recommended Books:

1. M.L. Hellickson and J.N. Walker, 'Ventilation of Agricultural Structures'.
2. L.P. Bengtsson, 'Farm Structures in Tropical Climates'.
3. J.H. Whitaker, 'Agricultural Buildings and Structures. National Food & Energy'.
4. R.E. Phillips, 'Farm Buildings: From Planning to Completion'.
5. ASAE, 'Environmental Control for Animals and Plants Textbooks'.
6. J.S. Boyd, 'Practical Farm Buildings', A Textbook & Handbook.

SOIL AND WATER CONSERVATION STRUCTURES

Subject Code: BTAG502-19

Unit – I

Introduction and classification of structures, Functional requirements of soil erosion control structures. Flow in open channels, types of flow, state and regimes of flow. Concept of Specific energy and specific force. Runoff measuring structures-H flume and Parshall flume.

Unit – II

Hydraulic jump and its application, Energy dissipation due to jump, jump efficiency and relative loss of energy, Runoff measuring structures; General description of straight drop spillway, structural parts and functions, advantages and disadvantages of spillway. Hydrologic and hydraulic design.

Unit - III

Structural design of a drop spillway, Safety against sliding, overturning, crushing and tension, Chute spillway, general description and its components; Hydraulic design, energy dissipaters and design criteria of a SAF stilling basin and its limitations.

Unit –IV

Drop inlet spillway, general description, functional use and design criteria. Design of diversions. Small earth embankments, types and design principles. Maintenance of earthen dams. Farm ponds, site selection and their design and construction. Cost estimation of structures.

Recommended Books:

1. V.V.N. Murty, 'Land and Water Management Engineering', Kalyani Publication.
2. R. Suresh, 'Soil and Water Conservation Engineering', Standard Publishers, Distributors.

Ghanshyam Das, 'Hydrology and Soil Conservation Engineering', PHI Learning Private Ltd

DAIRY AND FOOD ENGINEERING

Subject Code: BTAG503-19

Unit - I

Dairy development in India. Engineering, chemical and thermal properties of milk and milk products (In brief), Composition and proximate analysis of food products.

Unit - II

Unit operation of various dairy and food processing systems, process flow charts for product manufacture, Deterioration in products and their controls.

Unit - III

Working principles of equipment for receiving, pasteurization, sterilization, homogenization, filling & packaging (Production of butter, Pannier & Cheese) dairy plant design and layout, composition and proximate analysis of food products. Determination in products and their controls.

Unit - IV

Physical, chemical and biological methods of food preservation, changes during processing, evaporation, drying, freezing juice extraction, filtration, membrane separation, thermal processing, plant utilities requirement.

Recommended Books:

1. Sharma, 'Dairy Science and Technology and Food and Dairy Engineering', 1st Edn., CBS, **2009**.
2. J.G. Brennan, Butters, Jr. N.D. Cowell and A.E.V. Lilly, 'Food Engineering Operations', Applied Science Publishers, **1976**.
3. A.W. Farrall, 'Engineering for Dairy and Food Products', Wiley Eastern Pvt. Ltd., New Delhi, **1967**.
4. H.G. Kessler, 'Food Engineering and Dairy Technology', V.A. Kessler, Frcising, Germany, **1981**.
5. Tufail Ahmad, 'Dairy Plant Engineering and Management', Kitab Mahal, **2003**.

TRACTOR SYSTEMS, CONTROL & OPERATION

Subject Code: BTAG504-19

Unit- I

Study of transmission systems, clutch, gear box, differential and final drive mechanism. Familiarization of brake mechanism. Ackerman and hydraulic steering and hydraulic systems.

Unit-II

Tractor power outlets: P.T.O., belt pulley, drawbar, etc. Tractor chassis mechanics and design for tractor stability.

Unit-III

Ergonomic considerations and operational safety, Introduction to tractor maintenance procedure and trouble shooting. Scheduled maintenance after 10, 50, 100, 250, 500 and 1000 Hrs. of operation. Safety hints.

Unit-IV

Top end overhauling. Fuel saving tips. Preparing the tractor for storage. Care and maintenance procedure of agricultural machinery during operation and off-season. Repair and maintenance and workshop requirements.

Recommended Books:

1. F.R. Jones, 'Farm Gas Engines and Tractors'.
2. E.L. Barger, Lijedehl, W.B. Carleton and E.G. Mc Kibben, 'Tractors and their Power Units'.
3. Radhey Lal and Dutta, 'Agricultural Engineering through solved examples'.
4. Irving Frazeee and V.E. Philip, 'Tractors and Crawlers'.

PRINCIPLES OF PLANT PROTECTION

Subject Code: BTAG505-19

Unit I

Insect Ecology- Introduction, environment and its components, effect of abiotic and biotic factors. Biotic potential, environmental resistance and causes of pest outbreaks in agro-ecosystem. Categories of pests. Insects, Pests and Crop Losses; Present agriculture and pest problems. Beneficial insects: important pollinators, weed killers and scavengers; their importance. Important non-insect pests: mites, rodents and birds.

Unit II

Introduction, importance and general characters of fungi, bacteria, fastidious bacteria, nematodes, phytoplasmas, spiroplasmas, viruses, viroids, algae, protozoa and phanerogamic parasites. Definition, objectives, history, terms and concept of plant pathology.

Unit III

Insect pest and diseases of major field and horticultural crops and their management.

Unit IV

Plant protection equipments.

Recommended Books:

1. Introduction to Principles of Plant Pathology by R.S. Singh
2. Agricultural Pests of South Asia and Their Management. A. S. Atwal and G.S Dhaliwal. Kalyani Publishers, Ludhiana.
3. Principles of Insect Pest Management. G. S. Dhaliwal and Ramesh Arora. National Agricultural Technology Information Centre, Ludhiana.
4. Entomology at a Glance. R.C. Saxena and R. C. Srivastava. Agrotech Publishing Academy, Udaipur.

PROTECTED CULTIVATION AND POST HARVEST TECHNOLOGY

Subject Code: BTAG506-19

Unit I

Introduction, planning, design and application of green houses. Plant response to greenhouse environment. Green house equipment. Materials of construction for traditional and low cost green houses. Irrigation systems used in greenhouses.

Unit II

Cost estimation and economic analysis. Winnowing. Groundnut decorticators. Maize and castor shellers. Drying- grain drying, types of drying, types of dryers.

Unit IV

Storage grain storage, types of storage structures. Cleaning and grading equipment for fruits and vegetables. Size reduction equipment. Evaporation- principle and types. Quality standards.

Unit IV

Crops selection and constraints of greenhouse cultivation. Growing media, drainage, flooding and leaching, soil pasteurization, nutrient film technique (NFT) / hydroponics.

SOIL AND WATER CONSERVATION STRUCTURES LAB.

Subject Code: BTAG507-19

EXPERIMENTS

1. Study of different parts of H-flume and Parshall flume.
2. Construction of specific energy and specific force diagram.
3. Measurement of hydraulic jump parameters and amount of energy dissipation.
4. Design of drop spillway.
5. Stability analysis of drop spillway
6. Design of Chute spillway.
7. Design of drop inlet spillway.
8. Design of small earthen embankments.
9. Design of a SAF energy dissipater.
10. Design of water harvesting structures.
11. Cost estimation of structures.
12. Visit to a watershed to understand the runoff pattern.

TRACTOR SYSTEMS, CONTROL & OPERATION LAB.

Subject Code: BTAG508-19

EXPERIMENTS

1. Introduction to transmission systems and components.
 2. Study of clutch functioning, parts and design problem on clutch system.
 3. Study of different types of gear box, calculation of speed ratios, design problems on gear box.
 4. Study on differential and final drive and planetary gears.
 5. Study of brake systems and some design problems; Steering geometry and adjustments.
 6. Study of hydraulic systems in a tractor, hydraulic trailer and some design problems.
 7. Traction performance of a tractor wheel.
 8. Finding C.G. of a tractor by weighing technique.
 9. Finding CG of a tractor using suspension/balancing techniques; Finding moment of Inertia of a tractor.
 10. Appraisal of various controls in different makes tractors in relation to anthropometric measurements.
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DAIRY AND FOOD ENGINEERING LAB.

Subject Code: BTAG509-19

EXPERIMENTS

1. Study of a composite pilot milk processing plant & equipment
2. Study of pasteurisers
3. Study of sterilizers
4. Study of homogenisers
5. Study of separators
6. Study of butter churners
7. Study of evaporators
8. Study of milk dryers
9. Study of freezers
10. Design of food processing plants & preparation of layout
11. Visit to multiproduct dairy product
12. Determination of physical properties of food products
13. Estimation of steam requirements
14. Estimation of refrigeration requirements in dairy & food plant
15. Visit to Food industry

PRINCIPLES OF PLANT PROTECTION LAB

Subject Code: BTAG510-19

1. Identification of various insect pests and diseases of important field and horticultural crops.
2. Principles and working of various plant protection equipment.

PROTECTED CULTIVATION AND POST HARVEST TECHNOLOGY LAB.

Subject Code: BTAG511-19

Practical: Study of different types of green houses. Calculation of air rate exchange system. Estimation of drying rate of agricultural products. Testing of soil and water suitability and fertigation requirements for greenhouses. Study of threshers, Winnowers, groundnut decorticator and maize and castor shellers - their components, operation and adjustments. Improved grain storage structures. Study of dryers, cleaners and graders. Visit to commercial greenhouses. Growing media - their preparation and pasteurization/sterilization.

Soft Skills-III

Subject Code: BTHU501-19

UNIT-1

ART OF WRITING: Introduction, Importance of Writing Creative Writing, Writing tips, Drawback of written communication. ART OF BUSINESS WRITING: Introduction, Business Writing, Business Letter, Format and Styles, Types of business letters, Art of writing correct and precise mails, Understand netiquette.

UNIT-2

BODY LANGUAGE: Introduction- Body Talk, Forms of body language, uses of body language, Body language in understanding Intra and Inter-Personal Relations, Types of body language, Gender differences, Gaining confidence with knowledge of Kinesics.

UNIT-3

TEAM BUILDING AND TEAM WORK: Introduction, Meaning, Characteristics of an effective team, Role of a Team Leader, Role of Team Members, inter group Collaboration Advantages, Difficulties faced, Group Exercises-Team Tasks and Role-Play, Importance of Group Dynamics.

UNIT-4

TIME MANAGEMENT: Introduction, the 80-20 Rule, three secrets of Time Management, Time Management Matrix, Effective Scheduling, Time Wasters, Time Savers, Time Circle Planner, Difficulties in Time Management, Overcoming Procrastination.

Recommended Books

1. K. Alex, S. Chand Publishers.
2. R.C. Sharma and Krishna Mohan, 'Business Correspondence and Report Writing', TMH, New Delhi, 2016.
3. N. Krishnaswami and T. Sriraman, 'Creative English for Communication', Macmillan.
4. Penrose, M. John, et al., 'Business Communication for Managers', Thomson South Western, New Delhi, 2007.
5. Holtz, Shel, 'Corporate Conversations', PHI, New Delhi, 2007.

MENTORING AND PROFESSIONAL DEVELOPMENT

Subject Code: BMPD501-19

Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities. For achieving the above, suggestive list of activities to be conducted are:

Part – A (Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B (Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

SEMESTER 6 th		Contact Hrs.			Marks			Credits
Subject Code	Subject Name	L	T	P	Int.	Ext.	Total	
BTAG601-19	Heat and Mass Transfer	2	0	0	40	60	100	2
BTAG602-19	Applied Electronics and Instrumentation	2	0	0	40	60	100	2
BTAG603-19	Fluid Mechanics and Open Channel Hydraulics	2	0	0	40	60	100	2
BTAG604-19	Entrepreneurship Development and Business Management	2	0	0	40	60	100	2
BTAG605-19	Strength of Materials	1	0	0	40	60	100	1
BTAG606-19	Engineering Hydrology	2	0	0	40	60	100	2
BTAG607-19	Engineering Properties of Biological Material & Food Quality	2	0	0	40	60	100	2
BTAG608-19	Drainage Engineering	2	0	0	40	60	100	2
BTAG609-19	Auto CAD Applications	0	0	4	60	40	100	2
BTAG610-19	Applied Electronics and Instrumentation Lab.	0	0	2	60	40	100	1
BTAG611-19	Fluid Mechanics and Open Channel Hydraulics Lab.	0	0	2	60	40	100	1
BTAG612-19	Entrepreneurship Development and Business Management Lab.	0	0	2	60	40	100	1
BTAG613-19	Strength of Materials Lab.	0	0	2	60	40	100	1
BTAG614-19	Engineering Hydrology Lab.	0	0	2	60	40	100	1
BTAG615-19	Engineering Properties of Biological Material & Food Quality Lab.	0	0	2	60	40	100	1
BTAG616-19	Drainage Engineering Lab.	0	0	2	60	40	100	1
BMPD601-19	Mentoring and Professional Development	0	0	2	Satisfactory / Un-Satisfactory			Non-Credit
Total		15	0	20	800	800	1600	24

After 6th semester, student will go for 8 Weeks in house/ Industrial Training, present a seminar and submit a report in defined format to the department.

HEAT AND MASS TRANSFER

Subject Code: BTAG601-19

Concept, modes of heat transfer, thermal conductivity of materials, measurement. General differential equation of conduction. One dimensional steady state conduction through plane and composite walls, tubes and spheres with and without heat generation. Electrical analogy. Insulation materials. Fins, Free and forced convection. Newton's law of cooling, heat transfer coefficient in convection. Dimensional analysis of free and forced convection. Useful non dimensional numbers.

Equation of laminar boundary layer on flat plate and in a tube. Laminar forced convection on a flat plate and in a tube. Combined free and forced convection. Introduction. Absorptivity, reflectivity and transmissivity of radiation. Black body and monochromatic radiation, Planck's law, Stefan- Boltzman law, Kirchoff's law, grey bodies and emissive power, solid angle, intensity of radiation.

Radiation exchange between black surfaces, geometric configuration factor. Heat transfer analysis involving conduction, convection and radiation by networks. Types of heat exchangers, fouling factor, log mean temperature difference, heat exchanger performance, transfer units. Heat exchanger analysis restricted to parallel and counter flow heat exchangers. Steady state molecular diffusion in fluids at rest and in laminar flow, Flick's law, mass transfer coefficients. Reynold's analogy.

Recommended Books:

1. Geankoplis C.J. 1978. Transport Processes and Unit Operations. Allyn and Bacon Inc., Newton, Massachusetts.
2. Holman J P. 1989. Heat Transfer. McGraw Hill Book Co., New Delhi.
3. Incropera F P and De Witt D P. 1980. Fundamentals of Heat and Mass Transfer. John Wiley and Sons, New York.
4. Gupta C P and Prakash R. 1994. Engineering Heat Transfer. Nem Chand and Bros., Roorkee.

APPLIED ELECTRONICS AND INSTRUMENTATION

Subject Code: BTAG602-19

Semiconductors. p—n junction. V—I characteristics of p—n junction. diode as a circuit element. rectifier. clipper. damper, voltage multiplier, capacitive filter. diode circuits for OR & AND (both positive and negative logic), bipolar junction transistor: operating point. classification (A,B & C) of amplifier. various biasing methods (fixed. self potential divider). h-parameter model of a transistor. analysis of small signal. CE amplifier. phase shift oscillator, analysis of differential amplifier using transistor. ideal OP-AMP characteristics. linear and non-linear applications of OP-AMP (adder. subtractor. integrator, active rectifier. comparator. differentiator. differential, instrumentation amplifier and oscillator). zener diode voltage regulator. transistor series regulator. current limiting. OP-AMP voltage regulators. Basic theorem of Boolean algebra. Combinational logic circuits(basic gates. SOP rule and Kmap). binary ladder D/A converter, successive approximation A/D converter, generalized instrumentation, measurement of displacement. temperature. velocity, force and pressure using potentiometer. resistance thermometer. thermocouples. Bourclen tube. LVDT. strain gauge and tacho-generator.

Recommended Books:

1. Mehta V K. Principles of Electronics. S. Chand and Co., New Delhi.
2. Shaney A K. Measurement of Electronics and Electronic Instrumentation. Khanna Publications.
3. Roy Chowdary. Integrated Electronics. John Wiley International.
4. Kumar Anand. Digital Electronics. A. PHI.
5. Gupta Sanjeev, Sonthosh Gupta. Electronic Devices and Circuits. Danapath Rai Publications.

FLUID MECHANICS AND OPEN CHANNEL HYDRAULICS**Subject Code: BTAG603-19**

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, meta centre and meta centric height, condition of floatation and stability of submerged and floating bodies; 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; 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; 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; Flow through orifices (Measurement of Discharge, Measurement of Time), Flow through Mouthpieces, Flow over Notches, Flow over weirs, Chezy's formula for loss of head in pipes, Flow through simple and compound pipes, Open channel design and hydraulics: Chezy's formula, Bazin's formula, Kutter's Manning's formula, Velocity and Pressure profiles in open channels, Hydraulic jump; Dimensional analysis and similitude: Rayleigh's method and Buckingham's 'Pi' theorem, types of similarities, dimensional analysis, dimensionless numbers. Introduction to fluid machinery.

Recommended Books:

1. Khurmi, R .S. 1970. A Text Book of Hydraulics, Fluid Mechanics and Hydraulic Machines S. Chand & Company Limited, New Delhi.
2. Modi P M and Seth S.M.1973. Hydraulics and Fluid Mechanics. Standard Book House, Delhi.
3. Chow V T 1983. Open Channel Hydraulics. McGraw Hill Book Co., New Delhi.
4. Lal Jagadish 1985. Fluid Mechanics and Hydraulics. Metropolitan Book Co.Pvt. Ltd., New Delhi.

ENTREPRENEURSHIP DEVELOPMENT AND BUSINESS MANAGEMENT**Subject Code: BTAG604-19**

Entrepreneurship, management – Management functions – planning- Organizing -Directing –motivation – ordering – leading – supervision-Communication and control – Capital – Financial management – importance of financial statements – balance sheet – profit and loss statement, Analysis of financial statements – liquidity ratios – leverage ratios, Coverage ratios – turnover ratios – profitability ratios, Agro-based industries – Project – project cycle – Project appraisal and evaluation techniques – undiscounted measures – payback period – proceeds per rupee of outlay, Discounted measures – Net Present Value (NPV) – Benefit-Cost Ratio (BCR) – Internal Rate of Return (IRR) – Net benefit investment ratio (N / K ratio) – sensitivity analysis-Importance of agribusiness in Indian economy International trade-WTO agreements – Provisions related to agreements in agricultural and food commodities. Agreements on agriculture (AOA) – Domestic supply, market access, export subsidies agreements on sanitary and phytosanitary (SPS) measures, Trade related intellectual property rights (TRIPS). Development (ED): Concept of entrepreneur and entrepreneurship Assessing overall business environment in Indian economy– Entrepreneurial and managerial characteristics- Entrepreneurship development Programmes (EDP)- Generation incubation and commercialization of ideas and innovations- Motivation and entrepreneurship development- Globalization and the emerging business entrepreneurial environment- Managing an enterprise: Importance of planning, budgeting, monitoring evaluation and follow-up managing competition. Role of ED in economic development of a country- Overview of Indian social, political systems and their implications for decision making by individual entrepreneurs- Economic system and its implications for decision making by individual entrepreneurs- Social responsibility of business. Morals and ethics in enterprise management- SWOT analysis- Government schemes and incentives for promotion of entrepreneurship. Government policy on small and medium enterprises (SMEs)/SSIs/MSME sectors- Venture capital (VC), contract farming (CF) and joint ventures (JV), public-private partnerships (PPP)- Overview of agricultural engineering industry, characteristics of Indian farm machinery industry.

Recommended Books:

1. Harsh, S.B., Conner, U.J. and Schwab, G.D. 1981. Management of the Farm Business. Prentice Hall Inc., New Jersey.
2. Joseph, L. Massie. 1995. Essentials of Management. Prentice Hall of India Pvt. Ltd., New Delhi.
3. Omri Rawlins, N. 1980. Introduction to Agribusiness. Prentice Hall Inc., New Jersey
4. Gittenger Price, J. 1989. Economic Analysis of Agricultural Projects. John Hopkins University, Press, London.

Slope and deflection of beams using integration techniques, moment area theorems and conjugate beam method. Columns and Struts. Riveted and welded connections. Stability of masonry dams. Analysis of statically intermediate beams. Propped beams. Fixed and continuous beam analysis using superposition, three moment equation and moment distribution methods.

Recommended Books:

1. Khurmi R.S. 2001. Strength of Materials S. Chand & Co., Ltd., New Delhi.
2. Junarkar S.B. 2001. Mechanics of Structures (Vo-I). Choratar Publishing House, Anand.
3. Ramamrutham S. 2003. Strengths of Materials. Dhanpat Rai and Sons, Nai Sarak, New Delhi.

ENGINEERING HYDROLOGY

Subject Code: BTAG606-19

Unit – I

Introduction: Hydrologic cycle; precipitation - forms, rainfall measurement, mass curve, hydrograph, mean rainfall depth, plotting position, estimation of missing data, test for consistency of rainfall records; interception infiltration; evaporation; evapo-transpiration estimation and measurement.

Unit – II

Runoff: Factors affecting, measurement; stage and velocity, rating curve, extension of rating curve; estimation of peak runoff rate and volume; rational method, Cook's method, SCS method, Curve number method. Geomorphology of watersheds – stream number, stream length, stream area, stream slope.

Unit – III

Hydrograph: Components, base flow separation, unit hydrograph theory, Unit hydrograph of different durations, dimensionless unit hydrograph, distribution hydrograph, synthetic unit hydrograph, uses and limitations of unit hydrograph.

Unit – IV

Head Water Flood Control: Methods, retards and their location; flood routing – graphical methods of reservoir flood routing, Muskingum method of flood routing; hydrology of dry land areas - drought and its classification; Introduction to watershed management and planning, Horton's laws.

Recommended Books:

1. Rajesh Srivastava, Ashu Jain, 'Engineering Hydrology', 1st Edn., McGraw Higher Ed., **2017**.
 2. V.V.N. Murty, 'Land and Water Management Engineering', Kalyani Publication.
 3. K. Subramanya, 'Engineering Hydrology', McGraw Higher Ed. Publication, **2013**.
 4. S.K. Garg, 'Water Resource Engineering and Hydrology', 1st Edn., K.H. Publications, **2010**.
 5. Engineers Zone Publications, 'Hydrology & Irrigation Engineering, 1st Edn., Engineers Zone Publications, **2016**.
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ENGINEERING PROPERTIES OF BIOLOGICAL MATERIAL & FOOD QUALITY

Subject Code: BTAG607-19

Unit – I

Importance of engineering properties of biological materials, Physical properties like shape, size, volume, density, roundness, sphericity, surface area.

Unit – II

Thermal properties like thermal conductivity, specific heat & thermal diffusivity measurement of colour, flavour, consistency, viscosity, texture and their relationship with food quality and composition.

Unit – III

Rheological characteristics like stress, strain time effects, rheological models and their equations, Aerodynamic characteristics and fractional properties of biological materials, Application of engineering properties in handling processing machines and storage structure.

Unit – IV

Objectives and need of food quality; Measurement of colour, flavour, consistency, viscosity, texture and their relationship with food quality and composition; Sampling; purpose, sampling techniques, sampling procedures for liquid, powdered and granular materials.

Recommended Books:

1. O.P. Singhal and D.V.K. Samuel, 'Engineering Properties of Biological Materials', Saroj Prakashan, Allahabad, **2003**.
2. N.N. Mohenensin, 'Physical Properties of Plant and Animal Materials', Routledge Publication.
3. M.A. Rao and S.S.H. Rizvi, 'Engineering Properties of Foods', 4th Edn., CRC Press, **2014**.
4. B. Hallstrom, H.F. Meffert, Th., W.E.L. Speiss, 'Physical Properties of Food'.
5. S. Sahin, & S.G. Summu, 'Physical Properties of Foods', New York: Springer, **2006**.

DRAINAGE ENGINEERING

Subject Code: BTAG608-19

Water logging- causes and impacts; drainage, objectives of drainage, familiarization with the drainage problems of the state; surface drainage coefficient, types of surface drainage, design of surface drains; sub-surface drainage: purpose and benefits, investigations of design parameters hydraulic conductivity, drainable porosity, water table; derivation of Hooghoudt's and Ernst's drain spacing equations; design of subsurface drainage system; drainage materials, drainage pipes, drain envelope; layout, construction and installation of drains; drainage structures; vertical drainage; bio-drainage; mole drains; salt balance, reclamation of saline and alkaline soils, leaching requirements, conjunctive use of fresh and saline water.

Recommended Books:

1. J.N. Luthin, 'Drainage Engineering', Wiley Eastern Pvt. Ltd. New Delhi.
 2. R.T. Thokal, Sunil Gorantiwar, A.G, Powar, 'Agricultural Drainage: Principles & Practices', 1st Edn., Westville Publishing House, New Delhi.
 3. A.M. Michael and T.P. Ojha , 'Principles of Agricultural Engineering', Vol.-II, 5th Edn., Jain Brothers, **2018**.
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AUTO CAD APPLICATIONS

Subject Code: BTAG609-19

Application of computers for design. CAD- Overview of CAD window – Explanation of various options on drawing screen. Study of draw and dimension tool bar. Practice on draw and dimension tool bar. Study of OSNAP, line thickness and format tool bar. Practice on OSNAP, line thickness and format tool bar. Practice on mirror, offset and array commands. Practice on trim, extend, chamfer and fillet commands. Practice on copy, move, scale and rotate commands. Drawing of 2 D- drawing using draw tool bar. Practice on creating boundary, region, hatch and gradient commands. Practice on Editing polyline- PEDIT and Explode commands. Setting of view ports for sketched drawings. Printing of selected view ports in various paper sizes. 2Ddrawing of machine parts with all dimensions and allowances- Foot step bearing and knuckle joint. Sectioning of foot step bearing and stuffing box. Drawing of hexagonal, nut and bolt and other machine parts. Practice on 3-D commands- Extrusion and loft. Practice on 3-D commands on sweep and press pull. Practice on 3-D Commands- revolving and joining. Demonstration on CNC machine and simple problems.

APPLIED ELECTRONICS AND INSTRUMENTATION LAB.

Subject Code: BTAG610-19

To study V-I characteristics of p-n junction diode: To study half wave. full wave and bridge rectifier: To study transistor characteristics in CE configurations: To design and study fixed and self bias transistor: To design and study potential divider bias transistor: To study a diode as clipper and clamper: To study a OP-AMP IC 741 as inverting and non- inverting amplifier: To study a OP-AMP IC 741 as differentiator and integrator to study a differential amplifier using two transistor: To study a OP-AMP IC 741 as differential amplifier: To study a zener regulator circuit: To study a OP-AMP IC 741 as a active rectifier: To study a OP-AMP IC 741 as a comparator: To familiarize with various types of transducers.

FLUID MECHANICS AND OPEN CHANNEL HYDRAULICS LAB.

Subject Code: BTAG611-19

Study of manometers and pressure gauges; Verification of Bernoulli's theorem; Determination of coefficient of discharge of venturi-meter 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 meta-centric 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.

ENTREPRENEURSHIP DEVELOPMENT AND BUSINESS MANAGEMENT LAB.

Subject Code: BTAG612-19

Preparation of business – Strengths Weaknesses Opportunities and Threats (SWOT) analysis, Analysis of financial statements (Balance Sheet, Profit loss statement). Compounding and discounting, Break-even analysis Visit to agro-based industries – I, Visit to agro-based industries – II Study of Agro-industries Development Corporation , Ratio analysis – I, Ratio analysis – II, Application of project appraisal technique – I(Undiscounted measures), Application of project appraisal technique – II(Discounted Measures), Formulation of project feasibility reports – Farm Machinery Project proposals as entrepreneur – individual and group - Presentation of project proposals in the class.

STRENGTH OF MATERIALS LAB.

Subject Code: BTAG613-19

To perform the tension test on metal specimen (M.S., C.I.), to observe the behaviour of materials under load, to calculate the value of E, ultimate stress, permissible stress, percentage elongation etc. and to study its fracture; To perform the compression test on; Concrete cylinders & cubes, C.I., M.S. & Wood specimens and to determine various physical and mechanical properties; To perform the bending test on the specimens; M.S. Girder, Wooden beam, Plain concrete beams & R.C.C. beam, and to determine the various physical and mechanical properties; To determine Young's modulus of elasticity of beam with the help of deflection produced at centre due to loads placed at centre & quarter points; To study the behaviour of materials (G.I. pipes, M.S., C.I.) under torsion and to evaluate various elastic constants; To study load deflection and other physical properties of closely coiled helical spring in tension and compression; To perform the Rockwell, Vicker's and Brinell's Hardness tests on the given specimens; To perform the Drop Hammer Test, Izod Test and Charpy's impact tests on the given specimens; To determine compressive & tensile strength of cement after making cubes and briquettes; To measure workability of concrete (slump test, compaction factor test); To determine voids ratio & bulk density of cement, fine aggregates and coarse aggregates; To determine fatigue strength of a given specimen; To write detail report emphasizing engineering importance of performing tension, compression, bending, torsion, impact and hardness tests on the materials.

ENGINEERING HYDROLOGY LAB.

Subject Code: BTAG614-19

EXPERIMENTS

1. Study and use of anemometer.
2. Study and use of evaporimeters.
3. Study and use of hygrometer.
4. Study and use of sunshine recorder.
5. Study and use of solar radiation instruments.
6. Measurement of precipitation by rain gauges.
7. Analysis of rainfall data.
8. Study of stream gauging instruments and measurement.
9. Development of hydrograph.
10. Run-off- computations.
11. Graphical analysis of flood routing.
12. Study of stage recorders and current meters.
13. Exercises on flood routing problems.

ENGINEERING PROPERTIES OF BIOLOGICAL MATERIAL & FOOD QUALITY LAB.

Subject Code: BTAG615-19

EXPERIMENTS

1. Determination of shape & size of agricultural Products.
2. Determination of volume and density.
3. Measurement of roundness.
4. Measurement of sphericity.
5. Determination of surface area of leaf.
6. Determination of thermal conductivity & thermal diffusivity.
7. Measurement of internal friction of product.
8. Measurement of viscosity of jam and jelly.
9. Measurement of texture of biscuits & confectionary.
10. Estimation of sulphur dioxide in foods.
11. Measurement of angle of repose and internal friction.
12. Determination of protein and carbohydrates in a given food sample.
13. Estimation of vitamin C in any food sample.

DRAINAGE ENGINEERING LAB.

Subject Code: BTAG616-19

In-situ measurement of hydraulic conductivity by single auger hole and inverse auger hole method; Estimation of drainage coefficients; installation of piezometer and observation wells; preparation of iso-bath and isobar maps; determination of drainable porosity; design of surface drainage systems; design of gravel envelop; design of subsurface drainage systems; determination of chemical properties of soil and water; study of drainage tiles and pipes; installation of sub-surface drainage system; cost analysis of surface and sub-surface drainage system.

MENTORING AND PROFESSIONAL DEVELOPMENT

Subject Code: BMPD601-19

Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities. For achieving the above, suggestive list of activities to be conducted are:

Part – A (Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B (Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

SEMESTER 7 th		Contact Hrs.			Marks			Credits
Subject Code	Subject Name	L	T	P	Int.	Ext.	Total	
BTAG701-19	10- weeks Industrial Attachment /Internship	0	0	20	100 (Institute)	50 (Industry)	150	10
BTAG702-19	10- weeks Experiential Learning On campus	0	0	20	100	50	150	10
BTAG703-19	8-weeks Training *	0	0	10	60	40	100	5
BTAG704-19	Educational Tour [#]	Satisfactory / Un-Satisfactory						2 (Non-Credit)
Total		0	0	50	260	140	400	25+2 (Non-Credit)

***8 weeks training after 6th semester during summer vacations.**

Educational tour during winter/January break.

SEMESTER 8 th		Contact Hrs.			Marks			Credits
Subject Code	Subject Name	L	T	P	Int.	Ext.	Total	
BTAG801-19	Post-Harvest Engineering of Agricultural & Horticultural Produce	1	0	0	40	60	100	1
BTAG802-19	Renewable Power Sources	1	0	0	40	60	100	1
BTAG803-19	Sources and Methods of Irrigation	1	0	0	40	60	100	1
BTAGXXX-19	Elective course 1	2	0	0	40	60	100	2
BTAGXXX-19	Elective course 2	2	0	0	40	60	100	2
BTAGXXX-19	Elective course 3	2	0	0	40	60	100	2
BTAG804-19	Post-Harvest Engineering of Agricultural & Horticultural Produce Lab.	0	0	2	60	40	100	1
BTAG805-19	Renewable Power Sources Lab.	0	0	2	60	40	100	1
BTAG806-19	Sources and Methods of Irrigation Lab.	0	0	2	60	40	100	1
BTAGXXX-19	Elective course 1 Lab.	0	0	2	60	40	100	1
BTAGXXX-19	Elective course 2 Lab.	0	0	2	60	40	100	1
BTAGXXX-19	Elective course 3 Lab.	0	0	2	60	40	100	1
BTAG807-19	Project Planning and Report Writing	0	0	10	60	40	100	10
Total		9	0	22	660	640	1300	25

LIST OF ELECTIVE COURSES AND THEIR PRACTICAL

1. Floods and Control Measures (BTAG808-19)
2. Wasteland Development (BTAG809-19)
3. Information Technology for Land and Water Management (BTAG810-19)
4. Remote Sensing and GIS Applications (BTAG811-19)
5. Management of Canal Irrigation System (BTAG812-19)
6. Minor Irrigation and Command Area Development (BTAG813-19)
7. Precision Farming Techniques for Protected Cultivation (BTAG814-19)
8. Water Quality and Management Measures (BTAG815-19)
9. Landscape Irrigation Design and Management (BTAG816-19)
10. Plastic Applications in Agriculture (BTAG817-19)
11. Mechanics of Tillage and Traction (BTAG818-19)
12. Farm Machinery Design and Production (BTAG819-19)
13. Human Engineering and Safety (BTAG820-19)

14. Tractor Design and Testing (BTAG821-19)
15. Hydraulic Drives and Controls (BTAG822-19)
16. Precision Agriculture and System Management (BTAG823-19)
17. Food Quality and Control (BTAG824-19)
18. Food Plant Design and Management (BTAG825-19)
19. Food Packaging Technology (BTAG826-19)
20. Development of Processed Products (BTAG827-19)
21. Process Equipment Design (BTAG828-19)
22. Photovoltaic Technology and Systems (BTAG829-19)
23. Waste and By-products Utilization (BTAG830-19)
24. Mechatronics (BTAG831-19)
25. Floods and Control Measures Lab. (BTAG832-19)
26. Wasteland Development Lab. (BTAG833-19)
27. Information Technology for Land and Water Management Lab. (BTAG834-19)
28. Remote Sensing and GIS Applications Lab. (BTAG835-19)
29. Management of Canal Irrigation System Lab. (BTAG836-19)
30. Minor Irrigation and Command Area Development Lab. (BTAG837-19)
31. Precision Farming Techniques for Protected Cultivation Lab. (BTAG838-19)
32. Water Quality and Management Measures Lab. (BTAG839-19)
33. Landscape Irrigation Design and Management Lab. (BTAG840-19)
34. Plastic Applications in Agriculture Lab. (BTAG841-19)
35. Mechanics of Tillage and Traction Lab. (BTAG842-19)
36. Farm Machinery Design and Production Lab. (BTAG843-19)
37. Human Engineering and Safety Lab. (BTAG844-19)
38. Tractor Design and Testing Lab. (BTAG845-19)
39. Hydraulic Drives and Controls Lab. (BTAG846-19)
40. Precision Agriculture and System Management Lab. (BTAG847-19)
41. Food Quality and Control Lab. (BTAG848-19)
42. Food Plant Design and Management Lab. (BTAG849-19)
43. Food Packaging Technology Lab. (BTAG850-19)
44. Development of Processed Products Lab. (BTAG851-19)
45. Process Equipment Design Lab. (BTAG852-19)
46. Photovoltaic Technology and Systems Lab. (BTAG853-19)
47. Waste and By-products Utilization Lab. (BTAG854-19)
48. Mechatronics Lab. (BTAG855-19)

POST-HARVEST ENGINEERING OF AGRICULTURAL & HORTICULTURAL PRODUCE

Subject Code: BTAG801-19

Cleaning and grading, aspiration, scalping; size separators, screens, sieve analysis, capacity and effectiveness of screens. Various types of separators: specific gravity, magnetic, disc, spiral, pneumatic, inclined draper, velvet roll, colour sorters, cyclone, shape graders. Size reduction: principle, Bond's law, Kick's law, Rittinger's law, procedure (crushing, impact, cutting and shearing), Size reduction machinery: Jaw crusher, Hammer mill, Plate mill, Ball mill. Material handling equipment. Drying: moisture content and water activity; Free, bound and equilibrium moisture content, isotherm, hysteresis effect, EMC determination, Psychrometric chart and its use in drying, Drying principles and theory, Thin layer and deep bed drying analysis, Falling rate and constant rate drying periods, maximum and decreasing drying rate period, drying equations, Different methods of drying, batch-continuous; mixing-non-mixing, Sunmechanical, conduction, convection, radiation, superheated steam, tempering during drying, Different types of grain dryers: bin, flat bed, LSU, columnar, RPEC, fluidized, rotary and tray. Mixing: Theory of mixing of solids and pastes, Mixing index, types of mixers for solids, liquid foods and pastes. Milling of wheat, rice, pulses, corn and oilseeds machines. By-products utilization.

Importance of processing of fruits and vegetables and flowers. Characteristics and properties of horticultural crops important for processing, Peeling: Different peeling methods and devices (manual peeling, mechanical peeling, chemical peeling, and thermal peeling), Slicing of horticultural crops: equipment for slicing, shredding, crushing, chopping, juice extraction, etc., Blanching: Importance and objectives; blanching methods, effects on food (nutrition, colour, pigment, texture), Chilling and freezing: Application of refrigeration in different perishable food products, Thermophilic, mesophilic & Psychrophilic micro-organisms, Chilling requirements of different fruits and vegetables, Freezing of food, freezing time calculations, slow and fast freezing, Equipment for chilling and freezing (mechanical & cryogenic), Cold storage heat load calculations and cold storage design, refrigerated vehicle and cold chain system, Dryers for fruits and vegetables, Osmo-dehydration, Packaging of horticultural commodities, Packaging requirements (in terms of light transmittance, heat, moisture and gas proof, micro organisms, mechanical strength), Common methods of storage, Low temperature storage, evaporative cooled storage, Controlled atmospheric storage, Modified atmospheric packaging, Preservation Technology, General methods of preservation of fruits and vegetables, Brief description and advantages and disadvantages of different physical/ chemical and other methods of preservation, Flowcharts for preparation of different finished products, Post harvest management and equipment for flowers, Quality control in fruit and vegetable processing industry. Food supply chain.

Recommended Books:

1. Chakraverty, A. Post Harvest Technology of cereals, pulses and oilseeds. Oxford & IBH publishing Co. Ltd., New Delhi.
2. Dash, S.K., Bebartta, J.P. and Kar, A. Rice Processing and Allied Operations. Kalyani Publishers, New Delhi.
3. Arthey, D. and Ashurst, P. R. 1966. Fruit Processing. Chapman and Hall, New York.
4. Pantastico, E.C.B. 1975. Postharvest physiology, handling and utilization of tropical and subtropical

- fruits and vegetables AVI Pub. Co., New Delhi.
5. Pandey, R.H. 1997. Postharvest Technology of fruits and vegetables (Principles and practices). Saroj Prakashan, Allahabad.

RENEWABLE POWER SOURCES

Subject Code: BTAG802-19

Concept and limitation of Renewable Energy Sources (RES), Criteria for assessing the potential of RES, Classification of RES, Solar, Wind, Geothermal, Biomass, Ocean energy sources, Comparison of renewable energy sources with non-renewable sources. Solar Energy: Energy available from Sun, Solar radiation data, solar energy conversion into heat through, Flat plate and Concentrating collectors, different solar thermal devices, Principle of natural and forced convection drying system, Solar Photo voltaics: p-n junctions. Solar cells, PV systems, Stand alone, Grid connected solar power station, Calculation of energy through photovoltaic power generation and cost economics. Wind Energy: Energy available from wind, General formula, Lift and drag. Basis of Wind energy conversion, Effect of density, Frequency variances, Angle of attack, Wind speed, Types of Windmill rotors, Determination of torque coefficient, Induction type generators, Working principle of wind power plant. Bio-energy: Pyrolysis of Biomass to produce solid, liquid and gaseous fuels. Biomass gasification, Types of gasifier, various types of biomass cook stoves for rural energy needs. Biogas: types of biogas plants, biogas generation, factors affecting biogas generation and usages, design consideration, advantages and disadvantages of biogas spent slurry.

Energy consumption pattern & energy resources in India. Renewable energy options, potential and utilization. Biogas technology and mechanisms, generation of power from biogas, Power generation from urban, municipal and industrial waste. Design & use of different commercial sized biogas plant. Solar thermal and photovoltaic Systems for power generation. Central receiver (Chimney) and distributed type solar power plant, OTEC, MHD, hydrogen and fuel cell technology. Wind farms. Aero-generators. Wind power generation system. Power generation from biomass (gasification & Dendro thermal), Mini and micro small hydel plants. Fuel cells and its associated parameters.

Recommended Books:

1. Rai, G.D. 2013. Non-Conventional Energy Sources, Khanna Publishers, Delhi.
2. Rai, G.D., Solar Energy Utilization, Khanna Publishers, Delhi.
3. Garg H.P. 1990. Advances in Solar Energy Technology; D. Publishing Company, Tokyo.
4. Alan L: Farredbruch & R.H. Buse. 1983. Fundamentals of Solar Academic Press, London.
5. Bansal N.K., Kleemann M. & Meliss Michael. 1990. Renewable Energy Sources & Conversion Technology; Tata Mecgrow Publishing Company, New Delhi.
6. Rathore N. S., Kurchania A. K. & N.L. Panwar. 2007. Non Conventional Energy Sources, Himanshu Publications.

SOURCES AND METHODS OF IRRIGATION

Subject Code: BTAG803-19

Occurrence and movement of ground water; aquifer and its types; classification of wells, fully penetrating tubewells and open wells, familiarization of various types of bore wells; design of open wells; groundwater exploration techniques; methods of drilling of wells: percussion, rotary, reverse rotary; design of tubewell and gravel pack, installation of well screen, completion and development of well; groundwater hydraulics-determination of aquifer parameters by different method such as Theis, Jacob and Chow's, Theis recovery method; well interference, multiple well systems, estimation of ground water potential, quality of ground water; artificial groundwater recharge techniques; pumping systems: water lifting devices; different types of pumps, classification of pumps, component parts of centrifugal pumps, priming, pump selection, installation and trouble-shooting, performance curves, effect of speed on capacity, head and power, effect of change of impeller dimensions on performance characteristics; hydraulic ram, propeller pumps, mixed flow pumps and their performance characteristics; deep well turbine pump and submersible pump.

Sprinkler irrigation: adaptability, problems and prospects, types of sprinkler irrigation systems; design of sprinkler irrigation system: layout selection, hydraulic design of lateral, submain and main pipe line, design steps; selection of pump and power unit for sprinkler irrigation system; performance evaluation of sprinkler irrigation system: uniformity coefficient and pattern efficiency.

Micro Irrigation Systems: types-drip, spray, & bubbler systems, merits and demerits, different components; Design of drip irrigation system: general considerations, wetting patterns, irrigation requirement, emitter selection, hydraulics of drip irrigation system, design steps; necessary steps for proper operation of a drip irrigation system; maintenance of micro irrigation system: clogging problems, filter cleaning, flushing and chemical treatment; fertigation: advantages and limitations of fertigation, fertilizers solubility and their compatibility, precautions for successful fertigation system, fertigation frequency, duration and injection rate, methods of fertigation.

Recommended Books:

1. Michael AM, Khepar SD. and SK Sondhi. 2008. Water Well and Pumps, 2nd Edition, Tata Mc-Graw Hill.
2. Todd David Keith and Larry W. Mays. 2004. Groundwater Hydrology, 3rd Edition, John Wiley & Sons, New York (International Book Distributing Company Lucknow).
3. Michael AM. and Ojha TP. 2014. Principles of Agricultural Engineering Vol-II, 5th Edition. Jain Brothers
4. M.L. Choudhary and U.S. Kadam, 'Micro Irrigation for Cash Crops', Westville Publishing House, **2006**.
5. M.S. Mane and B.L. Ayare and S.S. Magar, 'Principles of Drip Irrigation Systems', Jain Brothers, New Delhi, **2006**.
6. A.M. Michael, 'Irrigation: Theory and Practice', Vikas Publishing House, New Delhi, **2012**.
7. R. Suresh, 'Principles of Micro-Irrigation Engineering', Standard Publishers Distributors, New Delhi, **2010**.

POST-HARVEST ENGINEERING OF AGRICULTURAL & HORTICULTURAL PRODUCE LAB.

Subject Code: BTAG804-19

Performance evaluation of different types of cleaners and separators, Determination of separation efficiency, Study of different size reduction machines and performance evaluation, Determination of fineness modulus and uniformity index, Study of different types of conveying and elevating equipments, Study of different types of mixers. Measurement of moisture content: dry basis and wet basis, Study on drying characteristics of grains and determination of drying constant, Determination of EMC (Static and dynamic method), Study of various types of dryers, Study of different equipments in rice mills and their performance evaluation, Study of different equipments in pulse mills and their performance evaluation, Study of different equipments in oil mills and their performance evaluation, Type of process flow charts with examples relating to processing of cereals pulses and oil seeds, Visit to grain processing industries.

Performance evaluation of peeler and slicer, Performance evaluation of juicer and pulper, Performance evaluation of blanching equipment, Testing adequacy of blanching, Study of cold storage and its design, Study of CAP and MAP storage, Minimal processing of vegetables, Preparation of value added products, Visit to fruit and vegetable processing industry.

RENEWABLE POWER SOURCES LAB.

Subject Code: BTAG805-19

Study of different types of solar cookers, solar water heating system, natural convection solar dryer, forced convection solar dryer, solar desalination unit, solar greenhouse for agriculture production, biogas plants, biomass gasifiers, biomass improved cook-stoves, solar photovoltaic system.

Performance evaluation of solar water heater; Performance evaluation of solar cooker; Characteristics of solar photovoltaic panel; evaluation of solar air heater/dryer; Performance evaluation of biomass gasifier engine system (throatless & downdraft), Performance evaluation of a fixed dome type biogas plant; Performance evaluation of floating drum type biogas plant; Estimation of calorific value of biogas & producer gas; Testing of diesel engine operation using dual fuel and gas alone.

SOURCES AND METHODS OF IRRIGATION LAB.

Subject Code: BTAG806-19

Verification of Darcy's Law; study of different drilling equipments; sieve analysis for gravel and well screens design; estimation of specific yield and specific retention; testing of well screen; estimation of aquifer parameters by Theis method, Coopers-Jacob method, Chow method; Theis Recovery method; well design under confined and unconfined conditions; well losses and well efficiency; estimating ground water balance; study of artificial ground water recharge structures; study of radial flow and mixed flow centrifugal pumps, multistage centrifugal pumps, turbine, propeller and other pumps; installation of centrifugal pump; testing of centrifugal pump and study of cavitations; study of hydraulic ram; study and testing of submersible pump.

Study of different components of sprinkler irrigation system; design and installation of sprinkler irrigation system; cost economics of sprinkler irrigation system; study of different components of drip irrigation; design and installation of drip irrigation system; determination of pressure discharge relationship and emission uniformity for given emitter; study of different types of filters and determination of filtration efficiency; determination of rate of injection and calibration for chemigation/fertigation; design of irrigation and fertigation schedule for crops; field visit to micro irrigation system and evaluation of drip system; cost economics of drip irrigation system.

ELECTIVE COURSES AND THEIR PRACTICAL

FLOODS AND CONTROL MEASURES

Floods - causes of occurrence, flood classification - probable maximum flood, standard project flood, design flood, flood estimation - methods of estimation; estimation of flood peak - rational method, empirical methods, unit hydrograph method. Statistics in hydrology, flood frequency methods - log normal, Gumbel's extreme value, log-Pearson type-III distribution; depth-area-duration analysis. Flood forecasting. Flood routing - channel routing, Muskingum method, reservoir routing, modified Pul's method. Flood control - history of flood control, structural and non-structural measures of flood control, storage and detention reservoirs, levees, channel improvement. Gully erosion and its control structures - design and implementation. Ravine control measures. River training works, planning of flood control projects and their economics. Earthen embankments - functions, classification - hydraulic fill and rolled fill dams - homogeneous, zoned and diaphragm type, foundation requirements, grouting, seepage through dams, flow net and its properties, seepage pressure, seepage line in composite earth embankments, drainage filters, piping and its causes. Design and construction of earthen dam, stability of earthen embankments against failure by tension, overturning, sliding etc., stability of slopes - analysis of failure by different methods. Subsurface dams - site selection and constructional features. Check dam - Small earthen embankments - types and design criteria. Subsurface dams - site selection and constructional features.

FLOODS AND CONTROL MEASURES LAB.

Determination of flood stage-discharge relationship in a watershed. Determination of flood peak-area relationships. Determination of frequency distribution functions for extreme flood values using Gumbel's method. Determination of confidence limits of the flood peak estimates for Gumbel's extreme value distribution. Determination of frequency distribution functions for extreme flood values using log-Pearson Type-III distribution. Determination of probable maximum flood, standard project flood and spillway design flood. Design of levees for flood control. Design of jetties. Study of vegetative and structural measures for gully stabilization. Design of gully/ravine control structures and cost estimation. Designing, planning and cost-benefit analysis of a flood control project. Study of different types, materials and design considerations of earthen dams.

Determination of the position of phreatic line in earth dams for various conditions, stability analysis of earthen dams against head water pressure, foundation shear, sudden draw down condition etc. Stability of slopes of earth dams by friction circle and other methods. Construction of flow net for isotropic and anisotropic media. Computation of seepage by different methods. Determination of settlement of earth dam. Input-output-storage relationships by reservoir routing. Visit to sites of earthen dam and water harvesting structures.

WASTELAND DEVELOPMENT

Land degradation – concept, classification - arid, semiarid, humid and sub-humid regions, denuded range land and marginal lands. Wastelands - factors causing, classification and mapping of wastelands, planning of wastelands development - constraints, agroclimatic conditions, development options, contingency plans. Conservation structures – gully stabilization, ravine rehabilitation, sand dune stabilization, water harvesting and recycling methods. Afforestation - agro-horti-forestry-silvipasture methods, forage and fuel crops - socioeconomic constraints. Shifting cultivation, optimal land use options. Wasteland development – hills, semi-arid, coastal areas, water scarce areas, reclamation of waterlogged and salt-affected lands. Mine spoils- impact, land degradation and reclamation and rehabilitation, slope stabilization and mine environment management. Micro-irrigation in wastelands development. Sustainable wasteland development - drought situations, socio-economic perspectives. Government policies. Participatory approach. Preparation of proposal for wasteland development and benefit-cost analysis.

WASTELAND DEVELOPMENT LAB.

Mapping and classification of wastelands. Identification of factors causing wastelands. Estimation of vegetation density and classification. Planning and design of engineering measures for reclamation of wastelands. Design and estimation of different soil and water conservation structures under arid, semiarid and humid conditions. Planning and design of micro-irrigation in wasteland development. Cost estimation of the above measures / structures. Visit to wasteland development project sites.

INFORMATION TECHNOLOGY FOR LAND AND WATER MANAGEMENT

Concept of Information Technology (IT) and its application potential. Role of IT in natural resources management. Existing system of information generation and organizations involved in the field of land and water management. Application and production of multimedia. Internet application tools and web technology. Networking system of information. Problems and prospects of new information and communication technology. Development of database concept for effective natural resources management. Application of remote sensing, geographic information system (GIS) and GPS. Rational data base management system. Object oriented approaches. Information system, decision support systems and expert systems. Agricultural information management systems - use of mathematical models and programmes. Application of decision support systems, multi sensor data loggers and overview of software packages in natural resource management. Video-conferencing of scientific information.

INFORMATION TECHNOLOGY FOR LAND AND WATER MANAGEMENT LAB.

Multimedia production. Internet applications: E-mail, voice mail, web tools and technologies. Handling and maintenance of new information technologies and exploiting their potentials. Exercises on database management using database and spreadsheet programmes. Usage of remote sensing, GIS and GPS survey in information generation and processing. Exercises on running computer software packages dealing with water balance, crop production, land development, land and water allocation, watershed analysis etc. Exercises on simple decision support and expert systems for management of natural resources. Multimedia production using different softwares. Exercises on development of information system on selected theme(s). Video-conferencing of scientific information.

REMOTE SENSING AND GIS APPLICATIONS

Basic component of remote sensing (RS), advantages and limitations of RS, possible use of RS techniques in assessment and monitoring of land and water resources; electromagnetic spectrum, energy interactions in the atmosphere and with the Earth's surface; major atmospheric windows; principal applications of different wavelength regions; typical spectral reflectance curve for vegetation, soil and water; spectral signatures; different types of sensors and platforms; contrast ratio and possible causes of low contrast; aerial photography; types of aerial photographs, scale of aerial photographs, planning aerial photography- end lap and side lap; stereoscopic vision, requirements of stereoscopic photographs; air-photo interpretation- interpretation elements; photogrammetry- measurements on a single vertical aerial photograph, measurements on a stereo-pair- vertical measurements by the parallax method; ground control for aerial photography; satellite remote sensing, multispectral scanner- whiskbroom and push-broom scanner; different types of resolutions; analysis of digital data- image restoration; image enhancement; information extraction, image classification, unsupervised classification, supervised classification, important consideration in the identification of training areas, vegetation indices; microwave remote sensing. GI Sand basic components, different sources of spatial data, basic spatial entities, major components of spatial data, Basic classes of map projections and their properties, Methods of data input into GIS, Data editing, spatial data models and structures, Attribute data management, integrating data (map overlay) in GIS, Application of remote sensing and GIS for the management of land and water resources.

REMOTE SENSING AND GIS APPLICATIONS LAB.

Familiarization with remote sensing and GIS hardware; use of software for image interpretation; interpretation of aerial photographs and satellite imagery; basic GIS operations such as image display; study of various features of GIS software package; scanning, digitization of maps and data editing; data base query and map algebra. GIS supported case studies in water resources management.

MANAGEMENT OF CANAL IRRIGATION SYSTEM

Purpose benefits and ill effects of irrigation; typical network of canal irrigation system and its different physical components; canal classification based on source of water, financial output, purpose, discharge and alignment; canal alignment: general considerations for alignment; performance indicators for canal irrigation system evaluation, Estimation of water requirements for canal command areas and determination of canal capacity; water duty and delta, relationship between duty, base period and delta, factors affecting duty and method of improving duty; silt theory: Kennedy's theory, design of channels by Kennedy's theory, Lacey's regime theory and basic regime equations, design of channels by Lacey's theory, maintenance of unlined irrigation canals, measurement of discharge in canals, rostering (canal running schedule) and warabandhi, necessity of canal lining: advantages and disadvantages, types of canal lining and desirable characteristics for the suitability of lining materials; design of lined canals; functions of distributary head and cross regulators; canal falls, their necessity and factors affecting canal fall; sources of surplus water in canals and types of canal escapes; requirements of a good canal outlet and types of outlet.

MANAGEMENT OF CANAL IRRIGATION SYSTEM LAB.

Estimation of water requirement of canal commands; determination of canal capacity; layout of canal alignments on topographic maps, drawing of canal sections in cutting, full banking and partial cutting and partial banking; determination of longitudinal section of canals; design of irrigation canals based on silt theories; design of lined canals; formulation of warabandhi; Study of canal outlets, regulators, escapes and canal falls.

MINOR IRRIGATION AND COMMAND AREA DEVELOPMENT

Factors affecting performance of irrigation projects; types of minor irrigation systems in India; lift irrigation systems: feasibility, type of pumping stations and their site selection, design of lift irrigation systems; tank Irrigation: grouping of tanks, storage capacity, supply works and sluices; command area development (CAD) programme- components, need, scope, and development approaches, historical perspective, command area development authorities functions and responsibilities; on farm development works, reclamation works, use of remote sensing techniques for CAD works; water productivity: concepts and measures for enhancing water productivity; Farmers' participation in command area development;

MINOR IRRIGATION AND COMMAND AREA DEVELOPMENT LAB

Preparation of command area development layout plan; Irrigation water requirement of crops; Preparation of irrigation schedules; Planning and layout of water conveyance system; design of surplus weir of tanks; determination of storage capacity of tanks; design of intake pipe and pump house.

PRECISION FARMING TECHNIQUES FOR PROTECTED CULTIVATION

Protected cultivation: Introduction, History, origin, development, National and International Scenario, components of green house, perspective, Types of green houses, polyhouses /shed nets, Cladding materials, Plant environment interactions – principles of limiting factors, solar radiation and transpiration, greenhouse effect, light, temperature, relative humidity, carbon dioxide enrichment, Design and construction of green houses – site selection, orientation, design, construction, design for ventilation requirement using exhaust fan system, selection of equipment, Greenhouse cooling system – necessity, methods – ventilation with roof and side ventilators, evaporative cooling, different shading material fogging, combined fogging and fanpad cooling system, design of cooling system, maintenance of cooling and ventilation systems, pad care etc. Greenhouse heating – necessity, components, methods, design of heating system. Root media – types – soil and soil less media, composition, estimation, preparation and disinfection, bed preparation. Planting techniques in green house cultivation. Irrigation in greenhouse and net house – Water quality, types of irrigation system, components, design, installation and material requirement. Fogging system for greenhouses and net houses – introduction, benefits, design, installation and material requirement. Maintenance of irrigation and fogging systems. Fertilization – nutrient deficiency symptoms and functions of essential nutrient elements, principles of selection of proper application of fertilizers, fertilizer scheduling, rate of application of fertilizers, methods, automated fertilizer application. Greenhouse climate measurement, control and management. Insect and disease management in greenhouse and net houses Selection of crops for greenhouse cultivation, major crops in greenhouse – irrigation requirement, fertilizer management, cultivation, harvesting and post harvest techniques; Economic analysis.

PRECISION FARMING TECHNIQUES FOR PROTECTED CULTIVATION LAB

Estimation of material requirement for construction of greenhouse ; Determination of fertilization schedule and rate of application for various crops; Estimation of material requirement for preparation of root media; Root media preparation, bed preparation and disinfections; Study of different planting techniques ; Design and installation of irrigation system; Design and installation of fogging system ; Greenhouse heating; Study of different greenhouse environment control instruments; Study of operation maintenance and fault detection in irrigation system; Study of operation maintenance and fault detection in fogging system; Economic analysis of greenhouses and net houses; Visit to greenhouses.

WATER QUALITY AND MANAGEMENT MEASURES

Natural factors affecting quality of surface water and groundwater, water quality objectives in relation to domestic, industrial and agricultural activities, drinking water quality standards, irrigation water quality classification as per USSL and All Indian Coordinated Research Project (AICRP) criteria, point and non-point water pollution sources, water contamination due to inorganic and organic compounds, water contamination related to agricultural chemicals, food industry, hydrocarbon and synthetic organic compounds. Arsenic and fluoride contamination in groundwater and remedial measures, water

decontamination technologies, cultural and management practices for using poor quality water for irrigation.

WATER QUALITY AND MANAGEMENT MEASURES LAB

Water quality analysis and classification according to USSL and AICRP criteria; soil chemical analysis and estimation of lime and gypsum requirements; study of salinity development under shallow and deep water table conditions; study of contamination movement and transport in soil profile; study of different water decontamination techniques; study of different cultural and management practices for using poor quality water for irrigation; field visit to industrial effluent disposal sites.

LANDSCAPE IRRIGATION DESIGN AND MANAGEMENT

Conventional method of landscape irrigation- hose irrigation system, quick release coupling system and portable sprinkler with hose pipes; Modern methods of landscape irrigation- popup sprinklers, spray pop-up sprinkler, shrub adopter, drip irrigation and bubblers; Merits and demerits of conventional and modern irrigation systems, types of landscapes and suitability of different irrigation methods, water requirement for different landscapes, Segments of landscape irrigation systems, Main components of modern landscape irrigation systems and their selection criteria; Types of pipes, pressure ratings, sizing and selection criteria; Automation system for landscape irrigation- main components, types of controllers and their application, Design of modern landscape irrigation systems, operation and maintenance of landscape irrigation systems.

LANDSCAPE IRRIGATION DESIGN AND MANAGEMENT

Study of irrigation equipments for landscapes; Design and installation of irrigation system for landscape, determination of water requirement. Determination of power requirement, pump selection. Irrigation scheduling of landscapes, Study of irrigation controllers and other equipments, Use of AutoCAD in irrigation design: blocks & symbols, head layout, zoning and valves layout, pipe sizing, Pressure calculations etc., Visit to landscape irrigation system and its evaluation.

PLASTIC APPLICATIONS IN AGRICULTURE

Introduction of plasticulture - types and quality of plastics used in soil and water conservation, production agriculture and post harvest management. Quality control measures. Present status and future prospective of plasticulture in India. Water management - use of plastics in in-situ moisture conservation and rain water harvesting. Plastic film lining in canal, pond and reservoir. Plastic pipes for irrigation water management, bore-well casing and subsurface drainage. Drip and sprinkler irrigation systems. Use of polymers in control of percolation losses in fields. Soil conditioning - soil solarisation, effects of different colour plastic mulching in surface covered cultivation. Nursery management - Use of plastics in nursery raising, nursery bags, trays etc. Controlled environmental cultivation - plastics as cladding material, green / poly / shade net houses, wind breaks, poly tunnels and crop covers. Plastic nets for crop protection - anti insect nets, bird protection nets. Plastic fencing. Plastics in drying, preservation, handling and storage

of agricultural produce, innovative plastic packaging solutions for processed food products. Plastic cap covers for storage of food grains in open. Use of plastics as alternate material for manufacturing farm equipment and machinery. Plastics for aquacultural engineering and animal husbandry - animal shelters, vermi-beds and inland fisheries. Silage film technique for fodder preservation. Agencies involved in the promotion of plasticulture in agriculture at national and state level. Human resource development in plasticulture applications.

PLASTIC APPLICATIONS IN AGRICULTURE LAB

Design, estimation and laying of plastic films in lining of canal, reservoir and water harvesting ponds. Study of plastic components of drip and sprinkler irrigation systems, laying and flushing of laterals. Study of components of subsurface drainage system. Study of different colour plastic mulch laying. Design, estimation and installation of green, poly and shade net houses, low tunnels etc. Study on cap covers for food grain storage, innovative packaging solutions - leno bags, crates, bins, boxes, vacuum packing, unit packaging, CAS and MAP and estimation. Study on use of plastics in nursery, plant protection, inland fisheries, animal shelters, preparation of vermi-bed and silage film for fodder preservation. Study of plastic parts in making farm machinery. Visits to nearby manufacturing units/dealers of PVC pipes, drip and sprinkler irrigation systems, greenhouse/ polyhouse/shadehouse/ nethouse etc. Visits to farmers' fields with these installations.

MECHANICS OF TILLAGE AND TRACTION

Introduction to mechanics of tillage tools, engineering properties of soil, principles and concepts, stress strain relationship, design of tillage tools principles of soil cutting, design equation, force analysis, application of dimensional analysis in soil dynamics and traction prediction equation. Introduction to traction and mechanics, off road traction and mobility, traction model, traction improvement, tyre size, tyre lug geometry and their effects, tyre testing, soil compaction and plant growth, variability and application of GIS in soil dynamics.

MECHANICS OF TILLAGE AND TRACTION LAB.

Measurement of static and dynamic soil parameters related to tillage, soil parameters related to puddling and floatation, draft for passive rotary and oscillating tools, slip and sinkage under dry and wet soil conditions and load and fuel consumption for different farm operations; Weight transfer and tractor loading including placement and traction aids; Studies on tyres, tracks and treads under different conditions, and soil compaction and number of operations.

FARM MACHINERY DESIGN AND PRODUCTION

Introduction to design parameters of agricultural machines & design procedure. Characteristics of farm machinery design. Research and development aspects of farm machinery. Design of standard power transmission components used in agricultural machines: mechanical & hydraulic units. Introduction to safety in power transmission. Application of design principles to the systems of selected farm machines.

Critical appraisal in production of Agricultural Machinery; Advances in material used for agricultural machinery. Cutting tools including CNC tools and finishing tools. Advanced manufacturing techniques including powder metallurgy, EDM (Electro-Discharge Machining), Heat Treatment of steels including pack carburizing, shot pining process, etc. Limits, Fits & Tolerances, Jigs & Fixtures. Industrial lay-out planning, Quality production management. Reliability. Economics of process selection. Familiarization with Project Report.

FARM MACHINERY DESIGN AND PRODUCTION LAB

Familiarization with different design aspects of farm machinery and selected components. Solving design problems on farm machines & equipment Visit to Agricultural machinery manufacturing industry, Tractor manufacturing industry Jigs and Fixtures study in relation to agricultural machinery. Fits, tolerances and limits; Layout planning of a small scale industry; Problems on Economics of process selection; Preparation of a project report; Case study for manufacturing of simple agricultural machinery.

HUMAN ENGINEERING AND SAFETY

Human factors in system development – concept of systems; basic processes in system development, performance reliability, human performance. Information input process, visual displays, major types and use of displays, auditory and factual displays. Speech communications. Biomechanics of motion, types of movements, Range of movements, strength and endurance, speed and accuracy, human control of systems. Human motor activities, controls, tools and related devices. Anthropometry: arrangement and utilization of work space, atmospheric conditions, heat exchange process and performance, air pollution. Dangerous machine (Regulation) act, Rehabilitation and compensation to accident victims, Safety gadgets for spraying, threshing, Chaff cutting and tractor & trailer operation etc.

HUMAN ENGINEERING AND SAFETY LAB

Calibration of the subject in the laboratory using bi-cycle ergo-meter. Study and calibration of the subject in the laboratory using mechanical treadmill; Use of respiration gas meter from human energy point of view. Use of Heart Rate Monitor. Study of general fatigue of the subject using Blink ratio method, Familiarization with electro-myograph equipment, anthropometric measurements of a selected subjects. Optimum work space layout and locations of controls for different tractors. Familiarization with the noise and vibration equipment. Familiarization with safety gadgets for various farm machines.

TRACTOR DESIGN AND TESTING

Procedure for design and development of agricultural tractor, Study of parameters for balanced design of tractor for stability & weight distribution, traction theory, hydraulic lift and hitch system design. Design of mechanical power transmission in agricultural tractors: single disc, multi disc and cone clutches. Rolling friction and anti-friction bearings. Design of Ackerman Steering and tractor hydraulic steering. Study of special design features of tractor engines and their selection viz. cylinder, piston, piston pin, crankshaft, etc. Design of seat and controls of an agricultural tractor. Tractor Testing.

TRACTOR DESIGN AND TESTING LAB.

Design problem of tractor clutch – (Single/ Multiple disc clutch). Design of gear box (synchromesh/constant mesh), variable speed constant mesh drive; Selection of tractor tires – Problem solving. Problem on design of governor. Design and selection of hydraulic pump. Engine testing as per BIS code. Drawbar performance in the lab; PTO test and measure the tractor power in the lab/field; Determining the turning space, turning radius and brake test, hydraulic pump performance test and air cleaner and noise measurement test; Visit to tractor testing centre/ industry.

HYDRAULIC DRIVES AND CONTROLS

Hydraulic Basics: Pascal's Law, Flow, Energy, Work, and Power. Hydraulic Systems, Color Coding, Reservoirs, Strainers and Filters, Filtering Material and Elements. Accumulators, Pressure Gauges and Volume Meters, Hydraulic Circuit, Fittings and Connectors. Pumps, Pump Classifications, operation, performance, Displacement, Design of Gear Pumps, Vane Pumps, Piston Pumps. 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 Assembly, Troubleshooting of Valves Hydraulic Circuit Diagrams and Troubleshooting, United States of American Standards Institute USASI Graphical Symbols Tractor hydraulics, nudging system, ADDC. Pneumatics: Air services, logic units, Fail safe and safety systems Robotics: Application of Hydraulics and Pneumatics drives in agricultural systems, Programmable Logic Controls (PLCs).

HYDRAULIC DRIVES AND CONTROLS LAB

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.

PRECISION AGRICULTURE AND SYSTEM MANAGEMENT

Precision Agriculture – need and functional requirements. Familiarization with issues relating to natural resources. Familiarization with equipment for precision agriculture including sowing and planting machines, power sprayers, land clearing machines, laser guided land levellers, strawchopper, straw-balers, grain combines, etc. Introduction to GIS based precision agriculture and its applications. Introduction to sensors and application of sensors for data generation. Database management. System concept. System approach in farm machinery management, problems on machinery selection, maintenance and scheduling of operations. Application to PERT and CPM for machinery system management.

PRECISION AGRICULTURE AND SYSTEM MANAGEMENT LAB

Familiarization with precision agriculture problems and issues. Familiarization with various machines for resource conservation. Solving problems related to various capacities, pattern efficiency, system limitation, etc. Problems related to cost analysis and inflation and problems related to selection of equipment, replacement, break-even analysis, time value of money etc.

FOOD QUALITY AND CONTROL

Basics of Food Science and Food Analysis, Concept, objectives and need of food quality. Measurement of colour, flavour, consistency, viscosity, texture and their relationship with food liquid, powdered and granular materials, Quality control, Quality control tools, Statistical quality control, Sensory evaluation methods, panel selection methods, Interpretation of sensory results. Instrumental method for testing quality. Food adulteration and food safety. TQM and TQC, consumer preferences and acceptance, Food Safety Management Systems GAP, GHP, GMP, Hazards and HACCP (Hazard analysis and critical control point), Sanitation in food industry (SSOP), Food Laws and Regulations in India, FSSAI, Food grades and standards BIS, AGMARK, PFA, FPO, ISO 9000, 22000 Series. CAC (Codex Alimentarius Commission), Traceability and Quality Assurance system in a process plant, Bio safety and Bioterrorism.

FOOD QUALITY AND CONTROL LAB

Examination of cereals & pulses from one of go-downs and market shops in relation to FPO and BIS specifications, Detection of adulteration and examination of ghee for various standards of AGMARK & BIS standards, Detection of adulteration and examination of spices for AGMARK and BIS standards, Detection of adulteration and examination of milk and milk products for BIS standards, Detection of adulteration and examination of fruit products such as jams, jellies, marmalades for FPO specification, Visit to quality control laboratory, Case study of statistical process control in food processing industry, Study of registration process and licensing procedure under FSSAI, Study of sampling techniques from food processing establishments, Visit to food processing laboratory and study of records and reports maintained by food processing laboratory.

FOOD PLANT DESIGN AND MANAGEMENT

Food plant location, selection criteria, Selection of processes, plant capacity, Requirements of plant building and its components, Project design, flow diagrams, selection of equipment, process and controls, Objectives and principles of food plant layout. Salient features of processing plants for cereals, pulses, oilseeds, horticultural and vegetable crops, poultry, fish and meat products, milk and milk products. Introduction to Finance, Food Product Marketing, Food Business Analysis and Strategic Planning, Introduction to Marketing, Food Marketing Management, Supply chain management for retail food products, Entrepreneurship development in food industry, SWOT analysis, generation, incubation and commercialization of ideas and innovations, New product development process, Government schemes and incentive for promotion of entrepreneurship, Govt. policy on small and medium scale food processing

enterprise, export and import policies relevant to food processing sector, procedure of obtaining license and registration under FSSAI, Cost analysis and preparation of feasibility report.

FOOD PLANT DESIGN AND MANAGEMENT LAB

Preparation of project report, Preparation of feasibility report, Salient features and layout of pre processing house, Salient features and layout of Milk and Milk product plants, Evaluation of given layout, Salient features, design and layout of modern rice mill, Salient features, design and layout of Bakery and related product plant, Study of different types of records relating to production of a food plant, Study of different types of records relating to finance of a food plant, Study of different types of records relating to marketing of a food business, Brain storming and SWOT analysis to start a food processing business.

FOOD PACKAGING TECHNOLOGY

Factors affecting shelf life of food material during storage, Interactions of spoilage agents with environmental factors as water, oxygen, light, pH, etc. and general principles of control of the spoilage agents; Difference between food infection, food intoxication and allergy. Packaging of foods, requirement, importance and scope, frame work of packaging strategy, environmental considerations, Packaging systems, types: flexible and rigid; retail and bulk; levels of packaging; special solutions and packaging machines, technical packaging systems and data management packaging systems, Different types of packaging materials, their key properties and applications, Metal cans, manufacture of two piece and three piece cans, Plastic packaging, different types of polymers used in food packaging and their barrier properties. manufacture of plastic packaging materials, profile extrusion, blown film/ sheet extrusion, blow molding, extrusion blow molding, injection blow molding, stretch blow molding, injection molding. Glass containers, types of glass used in food packaging, manufacture of glass and glass containers, closures for glass containers. Paper and paper board packaging, paper and paper board manufacture process, modification of barrier properties and characteristics of paper/ boards. Relative advantages and disadvantages of different packaging materials; effect of these materials on packed commodities. Nutritional labelling on packages, CAS and MAP, shrink and cling packaging, vacuum and gas packaging; Active packaging, Smart packaging, Packaging requirement for raw and processed foods, and their selection of packaging materials, Factors affecting the choice of packaging materials, Disposal and recycle of packaging waste, Printing and labelling, Lamination, Package testing: Testing methods for flexible materials, rigid materials and semi rigid materials; Tests for paper (thickness, bursting strength, breaking length, stiffness, tear resistance, folding endurance, ply bond test, surface oil absorption test, etc.), plastic film and laminates (thickness, tensile strength, gloss, haze, burning test to identify polymer, etc.), aluminium foil (thickness, pin holes, etc.), glass containers (visual defects, colour, dimensions, impact strength, etc.), metal containers (pressure test, product compatibility, etc.).

FOOD PACKAGING TECHNOLOGY LAB

Identification of different types of packaging materials, Determination of tensile/ compressive strength of given material/package, To perform different destructive and non-destructive tests for glass containers, Vacuum packaging of agricultural produces, Determination of tearing strength of paper board, Measurement

of thickness of packaging materials, To perform grease-resistance test in plastic pouches, Determination of bursting strength of packaging material, Determination of water-vapour transmission rate, Shrink wrapping of various horticultural produce, Testing of chemical resistance of packaging materials, Determination of drop test of food package and visit to relevant industries.

DEVELOPMENT OF PROCESSED PRODUCTS

Process design, Process flow chart with mass and energy balance, Unit operations and equipments for processing, New product development, Technology for value added products from cereal, pulses and oil seeds, Milling, puffing, flaking, Roasting, Bakery products, snack food. Extruded products, oil extraction and refining, Technology for value added products from fruits, vegetables and spices, Canned foods, Frozen foods, dried and fried foods, Fruit juices, Sauce, Sugar based confection, Candy, Fermented food product, spice extracts, Technology for animal produce processing, meat, poultry, fish, egg products, Health food, Nutra-ceuticals and functional food, Organic food.

DEVELOPMENT OF PROCESSED PRODUCTS LAB

Process design and process flow chart preparation, preparation of different value added products, Visit to roller wheat flour milling, rice milling, spice grinding mill, milk plant, dal and oil mill, fruit/vegetable processing plants & study of operations and machinery, Process flow diagram and study of various models of the machines used in a sugar mill.

PROCESS EQUIPMENT DESIGN

Introduction on process equipment design, Application of design engineering for processing equipments, Design parameters and general design procedure, Material specification, Types of material for process equipments, Design codes, Pressure vessel design, Design of cleaners. Design of tubular heat exchanger, shell and tube heat exchanger and plate heat exchanger, Design of belt conveyer, screw conveyer and bucket elevator, Design of dryers. Design of milling equipments. Optimization of design with respect to process efficiency, energy and cost, Computer Aided Design.

PROCESS EQUIPMENT DESIGN LAB

Design of pressure vessel, cleaners, milling equipments, tubular heat exchanger, shell and tube type heat exchanger, plate heat exchanger, dryer, belt conveyer, bucket elevator, screw conveyer.

PHOTOVOLTAIC TECHNOLOGY AND SYSTEMS

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 amorphous silicon cell Thin Cadmium Telluride (CdTe) Cell, Copper Indium Gallium Selenide (CiGS) Cell, Thin film crystalline silicon solar cell. 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. 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, 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.

PHOTOVOLTAIC TECHNOLOGY AND SYSTEMS LAB

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, safe measurement of PV modules electrical characteristics and Commissioning of complete solar PV system.

WASTE AND BY-PRODUCTS UTILIZATION

Types and formation of by-products and waste; Magnitude of waste generation in different food processing industries; Uses of different agricultural by-products from rice mill, sugarcane industry, oil mill etc., Concept, scope and maintenance of waste management and effluent treatment, Temperature, pH, Oxygen demands (BOD, COD), fat, oil and grease content, metal content, forms of phosphorous and sulphur in waste waters, microbiology of waste, other ingredients like insecticide, pesticides and fungicides residues, Waste utilization in various industries, furnaces and boilers run on agricultural wastes and byproducts, briquetting of biomass as fuel, production of charcoal briquette, generation of electricity using surplus biomass, producer gas generation and utilization, Waste treatment and disposal, design, construction, operation and management of institutional community and family size biogas plants, concept of vermin-composting, Pretreatment of waste: sedimentation, coagulation, flocculation and floatation, Secondary treatments: Biological and chemical oxygen demand for different food plant waste– trickling filters, oxidation ditches, activated sludge process, rotating biological contractors, lagoons, Tertiary treatments: Advanced waste water treatment process-sand, coal and activated carbon filters , phosphorous, sulphur, nitrogen and heavy metals removal, Assessment, treatment and disposal of solid waste; and biogas generation, Effluent treatment plants, Environmental performance of food industry to comply with ISO-14001 standards.

WASTE AND BY-PRODUCTS UTILIZATION LAB

Determination of temperature, pH, turbidity solids content, BOD and COD of waste water, Determination of ash content of agricultural wastes and determination of un-burnt carbon in ash, Study about briquetting of agricultural residues, Estimation of excess air for better combustion of briquettes, Study of extraction of oil from rice bran, Study on bioconversion of agricultural wastes, Recovery of germ and germ oil from by-products of cereals, Visit to various industries using waste and food by-products.

MECHATRONICS

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

Mechanical Actuation Systems, Hydraulic & Pneumatic Actuation Systems, Electrical Actuation Systems, A.C. Motor, D.C. Motor, Stepper Motor. Signal conditioning process, filtering digital signal, multiplexers, data acquisition, digital signal processing, measurement system, pulse modulation, data presentation systems. System modelling & control, Mathematical Models, Engineering Systems, Electro-mechanical & Hydraulic mechanical Systems, Modelling Dynamic Systems, Transfer Functions, Control Modes, PID Controller. Micro-processor & computer, Computer and Interfacing, Micro-computer Structure, Micro-controllers, Application of Microcontrollers, PLC. Robotics, Robot components, robot classification and specification, Work envelopes, other basic parameters of robots. Robot applications, Robot applications in manufacturing, Material transfer and machine loading/ unloading, Processing operations like Welding & painting, Assembly operations, Inspection automation, Future applications.

MECHATRONICS LAB

Selection of sensor for a particular application from Catalogue/Internet. Design a mechatronics product/system and incorporate application of mechatronics for enhancing product values. To study the hardware and software of mechatronics kit. To move a table in X-direction within the range of proximity sensors using Control-X software. To run a motor with PLC. To run a conveyor with computer. To study the movement of actuating cylinders and sensors.