ADOPTION OF 4th DEANS COMMITTEE RECOMMENDATION IN IGKV, RAIPUR w. e .f. ACADEMIC SESSION 2008-09 (EMR- 30th July 2008 , 69th BOM 4th August 2008 and 62nd ACM- 12th September 2008)

DISTRIBUTION OF COURSES FOR
B. Tech. (Agricultural Engineering)

SECOND YEAR

1st Semester

1	APFE 211	Engg. Properties of Biological Materials and Food Quality	3	2	1
2	ECE 211	Soil Mechanics	3	2	1
3	SWE 211	Soil and Water Conservation Engineering	3	2	1
4	FMP 211	Farm Machinery and Equipment-I	3	2	1
5	FMP 212	Farm Power	3	2	1
6	SWE 212	Engineering Hydrology	3	2	1
7	EMA 211	Engineering Mathematics-III	3	3	0
8	EECO 211	Agribusiness Management and Trade	3	3	0
		Total	**24**	**18**	**6**

2nd Semester

1	FMP 221	Farm Machinery and Equipment-II	3	2	1
2	FMP 222	Renewable Energy Sources	3	2	1
3	SWE 221	Irrigation Engineering	4	3	1
4	APFE 221	Crop Process Engineering	3	2	1
5	ECE 221	Fluid Mechanics	3	2	1
6	EME 221	Theory of Machines	3	2	1
7	EME 222	Heat and Mass Transfer	2	2	0
8	FMP 223	O & M of Tractor and Farm Machinery-II	2	1	1
		Total	**23**	**16**	**7**

SECOND YEAR
(First Semester)

1. ENGINEERING PROPERTIES OF BIOLOGICAL MATERIALS & FOOD QUALITY
APFE 211 3 (2+1)

Importance of engineering properties of biological materials, Study of different physical and thermal characteristics of important biological materials like shape, size, volume, density, roundness, sphericity, surface area, specific heat, thermal conductivity, thermal diffusivity, etc. measurement of colour, flavour, consistency, viscosity, texture and their relationship with food quality and composition. Rheological characteristics like stress, strain time effects, rheological models and their equations. Aerodynamic characteristics and frictional properties. Application of engineering properties in handling processing machines and storage structures. Concept, objectives and need of quality, quality control, methods of quality control, sampling; purpose, sampling techniques, requirements and sampling procedures for liquid, powdered and granular materials, sensory quality control, panel selection methods, interpretation of sensory results in statistical quality control, TQM and TQC, consumer preferences and acceptance, Food Laws and Regulations in India. Food grades and standards BIS, AGMARK, PFA, FPO, CAC (Codex Alimantarious Commission), sanitation in food industry, GMP, HACCP (Hazard analysis and critical control point) and ISO 9000 Series.

Practical: To find the shape and size of grains and fruits and vegetables. To determine bulk density and angle of repose of grains. To determine the particle density/true density and porosity of solid grains. To find out the co-efficient of external and internal friction of different crops; To study the separating behaviour of a grain sample in a vertical wind tunner (Aspirator column). To find the thermal conductivity of different grains. To determine specific heat of some food grains. To determine cooking quality of rice. To determine impurities and invisible stress cracks in grains. Preparation of a ready reckoner of change in unit weight of food grains as affected by change in its moisture content (w.b.) (5% - 25%). Milling quality of paddy; Determination of hardness of food material; Detection of adulteration in food products viz. milk, ghee, honey etc.

Reference:

1. Mohesin, N.N. 1978. Physical Properties of Plants & Animals. Gordon & Breach Science Publishers , New York.
2. Prentice, J.H. 1984. Measurement in Rhelogical Properties of Food Stuffs.Elsevier Applied science Pub.Co. Inc. New York.
3. Rao, M.A. and Rizvi,S.H., 1995. Engineering Properties of Foods. Marcel Dekker Inc. New York.
4. Rizvi,S.S.H. and Mittal, 1992. Experimental Methods in Food Engineering. Van Nostarnd Reinhold, New York.

2. SOIL MECHANICS ECE 211 3 (2+1)

Introduction of soil mechanics, field of soil mechanics, phase diagram physical and index properties of soil classification of soils, general classification based on particles size, textural classification and I.S. soil classification system stress condition in soils, effective and neutral stress, elementary concept of Bousinesque and Wester guards analysis, newmark influence chart. Shear strength mohr stress circle, theoretical relationship between principle stress circle, theoretical relationship between principal stress mohr-coulomb failure theory, effective stress principle. Determination of shear perameters by direct shear to be circle, theoretical test. Numerical exercise based on various types of tests. Compaction composition of soils standard and modified protector test, abbot compaction and Jodhpur mini compaction text field compaction method and control. Consolidation of soil: Consolidation of soils, one dimensional consolidation spring analogy, Terzaghi's theory Laboratory consolidation text, calculation of void ratio and coefficient of volume change, Taylor's and Casagrand's method, determination of coefficient of consolidation. Earth pressure: Plastic equilibrium in soils, active and passive states, Rankine's theory of earth pressure active and passive earth pressure for cohesive soils, simple numerical exercise. Stability of slopes: Introduction to stability analysis of infinite and finite slopes friction circles method Taylor's stability number.

Practical: Determination of water content of soil; Determination of specific gravity of soil; Determination of field density of soil by core cutter method; Determination of field density by sand replacement method; Grain size analysis by sieving (Dry sieve analysis); Grain size analysis by hydrometer method; Determination of liquid limit by Casagrande's method; Determination of liquid limit by cone penetrometer and plastic limit; Determination of shrinkage limit; Determination of permeability by constant head method; Determination of permeability by variable head method; Determination of compaction properties by standard proctor test; Determination of shear parameters by Direct shear test; Determination of unconfined compressive strength of soil; Determination of shear parameters by Triaxial test; Determination of consolidation properties of soils.

References:

1. Arora, K.R. 2000. Soil Mechanics and Foundation Engineering. Standard Publishers and Distributors, New Delhi.
2. Capper, P.L. and Cassie, W.F. 1961.The Mechanics of Engineering soils. Asia Publishing House, Bombay.
3. Verma, B.P. 1996. Problems in Soil Mechanics and Foundation Engineering. Khanna Publishers, New Delhi.

3. SOIL AND WATER CONSERVATION ENGINEERING SWE – 211 3(2+1)

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; soil loss estimation – their various parameters; 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 - principles of gully control - vegetative and temporary structures; wind erosion - factors affecting wind erosion, mechanics of wind erosion, soil loss estimation, wind erosion control measures - vegetative, mechanical measures, wind breaks & shelter belts, sand dunes stabilization; sedimentation - sedimentation in reservoirs and streams, estimation and measurement, sediment delivery ratio, trap efficiency; characteristics of contours and preparation of contour maps; land use capability classification; grassed water ways and their design; introduction to water harvesting techniques; introduction to stream water quality and pollution.

Practical: Study of soil loss measurement techniques; Study of details of Coshocton wheel and multi-slot runoff samplers; Determination of sediment concentration through oven dry method; Problems on Universal Soil Loss Equation; Preparation of contour map of an area and its analysis; Design of vegetative waterways; Design of contour bunding system; Design of graded bunding system; Design of various types of bench terracing systems; Determination of rate of sedimentation and storage loss in reservoir; Design of Shelter belts and wind breaks.

References:

1. Hudson Norman, 1985.Soil Conservation. Cornell University Press Ithaka, New York, U.S.A.
2. Michael, A.M. and Ojha, T.P. 1997. Principles of Agricultural Engineering. Vol.-II, Jain Brothers Publishers, New Delhi.
3. Schwab, G.O., Frevert, R.K., Edminister, T.W. and Barnes, K.K. 1966. Soil and Water Conservation Engineering. John Wiley and Sons. Inc., New York.

4. FARM MACHINERY & EQUIPMENT- I FMP - 211 3 (2+1)

Objectives of farm mechanization. Classification of farm machines. Materials of construction & heat treatment. Principles of operation and selection of machines used for production of crops. Field capacities & economics. Tillage; primary and secondary tillage equipment. Forces acting on tillage tools. Hitching systems and controls. Draft measurement of tillage equipment : Earth moving equipment - their construction & working principles viz Bulldozer, Trencher, Elevators etc.; sowing, planting & transplanting equipment - their calibration and adjustments. Fertilizer application equipment. Weed control and Plant protection equipment - sprayers and dusters, their calibration, selection, constructional features of different components and adjustments.

Practical: Introduction to various farm machines, visit to implements shed and research hall; Field capacity and field efficiency measurement for at least two machines/implements; Draft & fuel consumption measurement for different implements under different soil conditions; Construction details, adjustments and working of M.B. plow, disc plow and discharrow and secondary tillage tools; Introduction, construction and working of earth moving equipment; Construction and working of rotavators and other rotary tillers, measurement of speed & working width; Working of seed-cum-fertilizer drills, planters and their calibration in field; Working of transplanters and operation; Weeding equipments and their use; Study of sprayers, dusters, measurement of nozzle discharge, field capacity etc.

References:

1. Culpin, C. 1978. Farm Machinery. Granada Publishing Ltd., London.
2. Kepner, R.A., Bainer, R. and Barger, E.L. 1987. Principles of Farm Machinery. C.S.B. Publishers and distributors, New Delhi.
3. Smith, H.P. and Wilkes, L.H. 1979. Farm Machinery and Equipment. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
4. Ojha, T.P. and Michael, A.M. 2001. Principals of Agricultural Engineering, Vol. I., Jain Brothers, New Delhi.
5. Sahay, J. 2001. Elements of Agricultural Engineering, Jain Brothers, New Delhi.

5. FARM POWER FMP 212 3 (2+1)

Sources of farm power -conventional & non-conventional energy sources. Classification of tractors and IC engines. Review of thermodynamic principles of IC (CI & SI) engines and deviation from ideal cycle. Study of engine components their construction, operating principles and functions. Engine systems : valves & valve mechanism. Fuel & air supply, cooling, lubricating, ignition, starting and electrical systems. Study of constructional details, adjustments & operating principles of these systems. 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, study of properties of coolants, anti freeze and anti-corrosion materials, lubricant types & study of their properties. Engine governing systems.

Practical: Introduction to different systems of an CI engine; Engine parts and functions, working principles etc; Valve system – study, construction and adjustments; Oil & Fuel - determination of physical properties; Air cleaning system; Fuel supply system of SI engine; Diesel injection system & timing; Cooling system, and fan performance, thermostat and radiator performance evaluation; Part load efficiencies & governing; Lubricating system & adjustments; Starting and electrical system; Ignition system; Tractor engine heat balance and engine performance curves; Visit to engine manufacturer/ assembler/ spare parts agency.

References:

1. Culpin, C. 1978. Farm Machinery. Granada Publishing Ltd., London.
2. Kepner, R.A., Bainer, R. and Barger, E.L. 1987. Principles of Farm Machinery. C.S.B. Publishers and distributors, New Delhi.
3. Smith, H.P. and Wilkes, L.H. 1979. Farm Machinery and Equipment. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
4. Ojha, T.P. and Michael, A.M. 2001. Principals of Agricultural Engineering, Vol. I., Jain Brothers, New Delhi.
5. Sahay, J. 2001. Elements of Agricultural Engineering, Jain Brothers, New Delhi.

6. ENGINEERING HYDROLOGY SWE - 212 3 (2+1)

Introduction; hydrologic cycle; precipitation - forms, rainfall measurement, mass curve, hydrograph, mean rainfall depth, frequency analysis of point rainfall, plotting position, estimation of missing data, test for consistency of rainfall records; interception; infiltration; evaporation; evapo-transpiration - estimation and measurement; geomorphology of watersheds - stream number, stream length, stream area, stream slope and Horton's laws; 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; 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; head water flood control - methods, retards and their location; flood routing - graphical methods of reservoir flood routing; hydrology of dry land areas - drought and its classification; introduction to watershed management and planning.

Practical: Visit to meteorological observatory; Study of different types of rain gauges; Exercise on analysis of rainfall data; Double mass curve technique; Determination of average depth of rainfall and frequency analysis; Study of stage recorders and current meters; Exercise on estimation of peak runoff rate and runoff volume; Exercises on hydrograph and unit hydrograph; Exercises on design and location of retards for channel improvement; Exercises on flood routing problems.

References:

1. Herman. 1978.Groundwater Hydrology. Bouwer, International Student edition. McGraw-Hill. Kogakusha Ltd. Tokyo. Japan.
2. Todd, D.K. 1989Ground Water Hydrology. or recent edition: Wiley International Edition. Toppan Company Ltd, Tokyo. Japan.
3. Mahajan, 2002. Groundwater : Surveys and investigation, SBS Scientific Book supplier, New Delhi.
4. Michael, A.M. and Kheper, S.D. 1998. Water Well and pump engineering. Tata McGraw Hill Pub. Co. Ltd., New Delhi.

7. ENGINEERING MATHEMATICS-III EMA – 211 3 (3+0)

Numerical analysis: Finite differences, various difference operators and their relationships, factorial notation, interpolation with equal intervals, Newton's forward and backward interpolation formulae, Bessel's and Stirling's central difference interpolation formulae, interpolation with unequal intervals, Newton's divided difference formula, Lagrange's interpolation formula; numerical differentiation, differentiation based on equal interval interpolation, first and second order derivatives by using Newton's forward and backward, Stirling's and Bessel's formulae; maxima and minima of a tabulated function, numerical integration, numerical integration by Trapezoidal, Simpson's and Weddle's rules; Difference equations, order of a difference equation, solution of linear difference equation, rules for finding complimentary function and particular integral; numerical solution of ordinary differential equations by Picard's method, Taylor's series method, Euler's method, modified Euler's method, Runge-Kutta method. Laplace transforms: Definition of Laplace transform, Laplace transforms of elementary functions, properties of Laplace transforms, inverse Laplace transforms, transforms of derivatives, integrals, transform of function multiplied by t^n, transform of function divided by t, convolution theorem; application of Laplace transforms to solve ordinary differential equations and simultaneous differential equations, Laplace transforms of unit step function, unit impulse function, periodic function.

References:

1. Grewal, B.S. 1983. Higher Engineering Mathematics, Khanna Publishing House, New Delhi.
2. Love, C.E. and Rainville, E.D. 1968. Differential and Integral calculus. The Macmillon Co. New York,
3. Prasad, Gorakh, 1986. Text book on Integral Calculus and elementary differential equations. Pothishala Pvt. Ltd., Allahabad.

8. AGRIBUSINESS MANAGEMENT AND TRADE EECO 211 3 (3+0)

Management concepts and principles, process of management, functions of management, concept of agribusiness and application of management principles to agribusiness, production, consumption, and marketing of agricultural products, agricultural processing, meaning and theories of international trade, WTO provisions for trade in agricultural and food commodities, India's contribution to international trade in food and agri – commodities.

References:

1. Mondy R. Waghe and Premeanx Shahe, R. 1995. Management Concepts, Practices and Skills. Prentice Hall, Inc. Englewood Cliffs, New Jersey.
2. Shukla, M.C. 2001. Business Organization and Management. S. Chand and Co., New Delhi.

SECOND YEAR
(Second Semester)

1. FARM MACHINERY & EQUIPMENT-II FMP 221 3 (2+1)

Principles & types of cutting mechanisms. Construction & adjustments of shear & impact-type cutting mechanisms. Crop harvesting machinery : mowers, windrowers, reapers, reaper binders and forage harvesters. Forage chopping & handling equipment. Threshing mechanics & various types of threshers. Threshers, straw combines & grain combines, maize harvesting & shelling equipment, Root crop harvesting equipment - potato, groundnut etc., Cotton picking & Sugarcane harvesting equipment. Principles of fruit harvesting tools and machines. Horticultural tools and gadgets. Testing of farm machine. Test codes & procedure. Interpretation of test results. Selection and management of farm machines for optimum performance.

Practical: Familiarization with various Farm machines related to harvesting, threshing, root harvesting, combine etc; Study of various types of mowers, constructional details, materials and working; Study of various types of reaper, constructional details, materials and working & performance; Study of various types of reaper binder, constructional details, materials and working; Study of various types of potato harvesters, constructional details, materials and working; Study of various types of groundnut harvesters, constructional details, materials and working & performance; Study of various types of forage harvester, constructional details, materials and working; Study of various types of sugarcane harvester, constructional details, materials and working; Study of various types of maize sheller, constructional details, materials and working & performance; Study of various types of threshers, constructional details, materials and working & performance; Study of various types of cotton pickers and strippers, constructional details, materials and working; Study of various types of harvester tools, constructional details, materials and working; Study of various types of combine harvester, constructional details, materials and working; Study of various types of straw combines, constructional details, materials and working; Study of various types of fruit harvester equipment, constructional details, materials and working.

References:

1. Culpin, C. 1978. Farm Machinery. Granada Publishing Ltd., London.
2. Kepner, R.A., Bainer, R. and Barger, E.L. 1987. Principles of Farm Machinery. C.S.B. Publishers and distributors, New Delhi.
3. Smith, H.P. and Wilkes, L.H. 1979. Farm Machinery and Equipment. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
4. Ojha, T.P. and Michael, A.M. 2001. Principals of Agricultural Engineering, Vol. I., Jain Brothers, New Delhi.
5. Sahay, J. 2001. Elements of Agricultural Engineering, Jain Brothers, New Delhi.

2. RENEWABLE ENERGY SOURCES FMP 222 3 (2+1)

Classification of energy sources; Introduction to renewable energy sources; characterization of biomass; types, construction, working principle, uses and safety/environmental aspects of different renewable energy devices like gasifiers, biogas plants, solar passive heating devices, photovoltaic cells and arrays; Brief introduction to wind energy, hydroelectric energy, ocean energy, briquetting and baling of biomass, biomass combustion, biodiesel preparation and energy conservation in agriculture.

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

References:

1. Culp, A.W. 1991: Principles of energy conversion. McGraw-Hill publishing Co.Inc. NewYork
2. Duffie, J.A. and Beckman, W.A.1991. Solar Engineering of thermal processes. John Wiley, NewYork.
3. Utilization in Agriculture, David Pimentel, Hand Book of Energy,, C.R.C. Press.
4. Garg, H.P. and Prakash, J. 1997Solar energy – Fundamentals and applications.: Tata McGraw-Hill Publishing Co.Inc. India
5. Odum, H.T. and Odum, E.C. 1976: Energy basis for man and nature. McGraw-Hill Publishing Co.Inc. NewYork.
6. Sukhatme, S.P. 1997 2/e Solar energy-principles of thermal collection and storage.: Tata McGraw-Hill publishing Co.Inc. India.

3. IRRIGATION ENGINEERING SWE 221 4 (3+1)

Irrigation Engineering: Irrigation, impact of irrigation on Human Environment, some major and medium irrigation schemes of India, purpose of irrigation, sources of irrigation water, present status of development and utilization of different water resources of the country; Measurement of irrigation water, weir, notches, flumes and orifices and other methods; water conveyance, design of irrigation field channels, underground pipe conveyance system, irrigation structures, channel lining; land grading, different design methods and estimation of earth work and cost; soil water plant relationship, soil water movement, infiltration, evapo-transpiration, soil moisture constants, depth of irrigation, frequency of irrigation, irrigation efficiencies; surface irrigation methods of water application, border, check basin, furrow and contour irrigation; sprinkler and drip irrigation method, merits, demerits, selection and design; Participatory irrigation management. Economics of water resources utilization.

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

References:

1. Ghosh, S.N. 1997. Flood Control and Drainage Engineering. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Israelson, O.W. and Hensen, V.E. 1962. Irrigation Principles & Practices, John Wiley and Sons, Inc., New York.
3. R.K. and Franzini, J.B. 1964. Water Resources Engineering. Linsley, McGraw-Hill Book Co. New York.
4. Luthin, J.N. 1957. Drainage of Agricultural Lands. American Society of Agronomy, U.S.A.
5. Michael, A.M. and Ojha, T.P. 1997. Principles of Agricultural Engineering, Vol. II. Jain Brothers, New Delhi.
6. Michael, A.M. 1997. Irrigation Theory & Practices, Vikas Publishing House, Pvt. Ltd., New Delhi.

4. CROP PROCESS ENGINEERING APFE 221 3 (2+1)

Scope and importance of food processing, principles and methods of food processing. Processing of farm crops; cereals, pulses, oil seeds, fruits and vegetables and their products for food and feed. Processing of animal products, Principal of size reduction, grain shape, size reduction machines; crushers, grinders, cutting machines etc. - operation, efficiency and power requirement – Rittinger's, Kick's and Bond's equation, fineness modulus. Theory of mixing, types of mixtures for dry and paste. materials, rate of mixing and power requirement, mixing index. Theory of separation, size and un sized separation, types of separators, size of screens, sieve analysis, capacity and effectiveness of screens, pneumatic separation. Theory of filtration, study of different types of filters, rate of filtration, pressure drop during filtration. Scope & importance of material handling devices, study of different types of material handling systems; belt, chain and screw conveyor, bucket elevator, pneumatic conveying, gravity conveyor- design consideration, capacity and power requirement.

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

References

1. Arthey, D. and Ashurst, P. R. 1966. Fruit Processing.. Chapman and Hall, NewYork.
2. Asiedu, J.J. 1990. Processing tropical crops. ELBS/Macmillan, NewYork.
3. Pantastico, E.C.B. 1975.Postharvest physiology, handling and utilization of tropical and subtropical fruits and vegetables. AVI Pub. Co., New Delhi.
4. Pandey, R.H. 1997. Postharvest Technology of Fruits and Vegetables (Principles and Practices). Saroj Prakashan, Allahabad.

5. FLUID MECHANICS ECE 221 3 (2+1)

Properties of fluids: Ideal and real fluid. Pressure and its measurement, Pascal's law, pressure forces on plane and curved surfaces, centre of pressure, buoyancy, metacentre and metacentric height, condition of floatation and stability of submerged and floating bodies; 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, shear stress and pressure gradient; Laminar and turbulent flow in pipes, general equation for head loss-Darcy, Equation, Moody's diagram, Minor and major hydraulic losses through pipes and fittings, flow through network of pipes, hydraulic gradient and energy gradient, power transmission through pipe; Dimensional analysis and similitude: Rayleigh's method and Buckingham's `Pi' theorem, types of similarities, dimensional analysis, dimensionless numbers. Introduction to fluid machinery.

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

References:

1. Fox, R.W. and McDonald, A.T. 1995. Introduction to Fluid Mechanics, John Willey and Sons.
2. Garde, R.J. 1992. Fluid Mechanics through Problems. Willey Eastern Ltd., New Delhi.
3. Lal, Jagdish. 1997Fluid Mechanics and Hydraulics. Metropolitan Book Co. Pvt. Ltd., New Delhi

6. THEORY OF MACHINES EME 221 3 (2+1)

Elements, links, pairs, kinematics chain, and mechanisms. Classification of pairs and mechanisms. Lower and higher pairs. Four bar chain, slider crank chain and their inversions. Determination of velocity and acceleration using graphical (relative velocity and acceleration) method. Instantaneous centers. Types of gears. Law of gearing, velocity of sliding between two teeth in mesh. Involute and cycloidal profile for gear teeth. Spur gear, nomenclature, interference and undercutting. Introduction to helical , spiral, bevel and worm gear. Simple, compound, reverted, and epicyclic trains. Determining velocity ratio by tabular method. Turning moment diagrams, co-efficient of fluctuation of speed and energy, weight of flywheel, flywheel applications. Belt drives, types of drives, belt materials. Length of belt, power transmitted, velocity ratio, belt size for flat and V belts. Effect of centrifugal tension, creep and slip on power transmission, Chain drives. Types of friction, laws of dry friction. Friction of pivots and collars. Single disc, multiple disc, and cone clutches. Rolling friction, anti friction bearings. Types of governors. constructional details and analysis of Watt, Porter, Proell governors. Effect of friction, controlling force curves. Sensitiveness, stability, hunting, isochronism, power and effort of a governor. Static and dynamic balancing. Balancing of rotating masses in one and different planes. Partial primary balancing of reciprocating meases.

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

References:

1. Beven, Thomas, 1984. The Theory of Machines. CBS Publishers & Distributors, New Delhi.
2. Ham, C.W., Crane, E.J., Rogers, W.L. 1988. Mechanics of Machinery. McGraw Hill Book Co., New York.
3. Khurmi, R.S. and Gupta, J.K. 1998. Theory of machines, Eurasia Publishing House,
   Ramnagar, New Delhi.
4. Shigley, J.E. 1961Theory of Machines.. McGraw Hill Book. Co. Inc. New York.

7. HEAT AND MASS TRANSFER EME 222 2 (2+0)

Introductory concepts, 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, critical thickness of insulation. 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 and empirical relationships for free and forced convection. 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.

References:

1. Arora, N. 1972. Engineering Thermodynamics Problems, Dhanpat Rai and Sons. New
   Delhi.
2. Ballancy, P.L. 1984Thermal Engineering. Khanna Publishers, New Delhi.
3. Jones, F.R. 1970Farm Gas Engines and Tractors,. Mc Graw. Hill Book Co. New York and London.
4. Rai, G.D. 1998Practical Thermodynamics.. Khanna Publishers, New Delhi.

8. OPERATION & MAINTENANCE OF TRACTORS AND FARM MACHINERY –II
FMP 223 2(1+1)

Introduction to tractor maintenance procedure and trouble shooting. Scheduled maintenance after 10,50,100,250,500 and 1000 hrs. of operation. Safety hints. Top end overhauling. 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.

Practical: Familiarisation with tools and equipment used for maintaining & servicing of tractors & farm machines; Doing the 10-hours service jobs & Maintenance after 50-hours of operation; Maintenance after 100 hours of operation; Maintenance after 250 hours of operation; Maintenance after 500 hours and 1000 hours of operation, adjustment of tractor track; Dismantling and assembling of major engine parts; Visit to tractor/ engine repair workshop, injection pump injector repair shop; Doing minor repair of electric, mechanical and hydraulic system; Adjustment and maintenance of primary and secondary tillage equipment viz. m.b. plough, disc-plough and disc harrow etc.; Adjustment and maintenance of seeding & planting and transplanting machines; Adjustment and maintenance of plant protection equipment; Adjustment and maintenance of reapers & threshers; Adjustment & maintenance of combine harvesters, straw combines, balers etc; Visit to small scale farm machinery manufacturers and their repair shops, seasonal repair of farm machinery.

References:

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