

**COURSE STRUCTURE AND SYLLABUS FOR M.TECH (FARM MACHINERY AND POWER ENGINEERING) PROGRAMME**

**DEPARTMENT OF AGRICULTURAL ENGINEERING AND TECHNOLOGY,  
SCHOOL OF ENGINEERING AND TECHNOLOGY  
NAGALAND UNIVERSITY, KOHIMA CAMPUS**

<b>SEMESTER 1</b>						
<b>S.N.</b>	<b>Course Code</b>	<b>Course title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
1	AEMT501	Tractor System Design –I	3	1	0	4
2	AEMT502	Design of Farm Machinery	3	1	0	4
3	AEMT503	Soil Dynamics in Tillage and Traction	2	1	2	4
4	AEMT504	Principles of Ergonomics	3	1	0	4
5	AEME5**	Elective I	3	1	0	4
6	AEME5**	Elective II	3	1	0	4
Total						24
<b>SEMESTER 2</b>						
<b>S.N.</b>	<b>Course Code</b>	<b>Course title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
1	AEMT505	Tractor System Design –II	3	1	0	4
2	AEMT506	Instrumentation for Agricultural Machines	2	1	2	4
3	AEMT507	Testing and Evaluation of Tractors and Farm Equipment	3	1	0	4
4	AEMT508	Alternative Sources of Energy	2	1	2	4
5	AEMT509	Testing and Evaluation of Tractors and Farm Equipment Lab	0	0	4	2
6	AEME5**	Elective III	3	1	0	4
Total						22
<b>SEMESTER 3</b>						
<b>S.N.</b>	<b>Course Code</b>	<b>Course title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
1	AEMT601	Research Methodology & Proposal Writing	3	1	0	4
1	AEME6**	Elective IV	3	1	0	4
2	AEME6**	Skill Enhancement Elective V	3	1	0	4
3	AEMT602	Seminar	0	3	0	3
4	AEMT603	M.Tech. Thesis (Part- I)	0	0	20	10
Total						25
<b>SEMESTER 4</b>						
<b>S.N.</b>	<b>Course Code</b>	<b>Course title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
1	AEMT604	M.Tech. Thesis (Part – II)	0	0	20	10
2	AEMT605	Comprehensive Viva-Voce	0	0	16	8
Total						18
<b>Grand total credit</b>						<b>89</b>

<b>Elective courses I and II</b>						
<b>S.N.</b>	<b>Course Code</b>	<b>Course title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
1	AEME501	Application of Programming in Farm Machinery Design and Management	3	1	0	4
2	AEME502	Material Science and Engineering for Selection and Design of Farm Machines	3	1	0	4

3	AEME503	Principles of Mechanization and Management	3	1	0	4
4	AEME504	Mechanization in Tea Production	3	1	0	4
<b>Elective courses III</b>						
S.N.	Course Code	Course title	L	T	P	Credits
1	AEME505	Safety and Health in Agriculture	3	1	0	4
2	AEME506	Statistical Methods in Agriculture	3	1	0	4
3	AEME507	Earth Moving Machinery	3	1	0	4
<b>Elective courses IV</b>						
S.N.	Course Code	Course title	L	T	P	Credits
1	AEME601	Human Resource Management	3	1	0	4
2	AEME602	Bio-fuel Production and Application	3	1	0	4
3	AEME603	Computerized Design of Agricultural Machines	3	1	0	4
<b>Skilled enhancement elective course V</b>						
1	AEME604	Precision Agricultural Machinery	3	1	0	4
2	AEME605	Project Management	3	1	0	4
3	AEME606	Industrial Safety	3	1	0	4

### **AEMT501 Tractor System Design-I**

- Engine performance characteristics, selection of engine for tractors. Design principles: engine components and engine systems.
- Design of tractor chassis. Tractor stability analysis: Longitudinal and lateral stability.
- Design of gearbox: Sliding mesh, constant mesh and Synchromesh gearbox. Design principles of CVT, automatic and dual clutch transmission.
- Design of clutch: Positive and friction clutch. Design of brake: Shoe, band and disc type. Differential and final drive
- Design and selection of wheels and tracks. Recent advances and trends of design of tractors and its systems.

#### **Recommended Books:**

1. Engine and Tractor Power, Carroll E. Goering and Alan C. Hansen, American Society of Agricultural Engineers. St. Joseph, Michigan, 2004.
2. Tractor and its Power Units, J.B. Liljedahl, W.M. Carleton, P.K. Turnquist and H. Makoto, 4<sup>th</sup> Ed., CBS Publishers & Distributors, New Delhi, 1997.
3. The Mechanics of Tractor - Implement Performance, R. H. Macmillan, University of Melbourne, 2002, printed from: <http://www.eprints.unimelb.edu.au>.

### **AEMT502 Design of Farm Machinery**

- Recent trends in design of farm machinery. Design of primary tillage implements: mouldboard plough, disc plough, chisel plough and subsoiler
- Design of secondary tillage implements: Single acting and double acting disc harrow, cultivator, and rotavator

- Design of seed drills and planter: Metering mechanism and power train. Design of vegetable and paddy transplanter.
- Design of fertilizer applicator and plant protection equipment. Design of harvesting and threshing machines for cereals, pulses and root crops.
- Design of different systems of combine harvester for grain crops. Design of tools for fruit, nut and vegetable harvesting.

**Recommended Books:**

1. Engineering Principles of Agricultural Machines, A.K. Srivastava, C.E. Goering and R.P. Rohrbach, ASAB E Publication, Michigan, 1993.
2. Agricultural Machines, Theory and Construction, Vol. I and II. H. Bernacki, J. Haman and C.Z. Kanafojski, Scientific Publications, Foreign Cooperation Centre of the Central Institute for Scientific, Technical and Economic Information, Warsaw, Poland, 1972.
3. Farm Machinery Design: Principles and Problems, D.N. Sharma and S. Mukesh, 3<sup>rd</sup> Ed., Jain Brothers, New Delhi, 2013.

**AEMT503 Soil Dynamics in Tillage and Traction**

- Mechanical properties of soil: Shear strength, adhesion, cohesion, and Mohr-Coulomb theory of soil failure. Measurement techniques for stress strain parameters and cone index of soil.
- Mechanics of wheel: Traction, towed and self-propelled wheel, rigid and elastic wheel. Mechanics of track. Traction parameters: Slip, rolling resistance, tractive effort, coefficient of traction
- Pneumatic wheels: Radial and bias ply tyre, specification, construction, load bearing capacity, deflection, contact area. Comparison of single and dual tyres.
- Evaluation of traction device. Effect of soil type and conditions, normal load, tyre parameters. on traction performance. Ballasting and its effects.
- Mechanics of simple tillage tools. Design consideration and performance evaluation of different tillage tools. Mechanics of rigid, rotary and oscillating tillage tools.

**Recommended Books:**

1. Soil Dynamics in Tillage and Traction, W.R. Gill and G.E. Vandenberg, ARS, USDA, 1968.
2. Theory of Land Locomotion, M.G. Bekker and Ann Arbor, The University of Michigan Press, Michigan, 1956.
3. Soil Cutting and Tillage, E. McKeyes, Elsevier, Tokyo, 1985.
4. Theory of Ground Vehicles, J.Y. Wong, John Wiley and Sons Inc., New York, 1993.

**AEMT504 Principles of Ergonomics**

- Definitions and development of ergonomics. Human-machine system. Anthropometry: Workspace design principles, seat design, tractor operator workplace layout.
- Physical work: Work physiology, physiological strain, physical workload, muscle physiology, physical and muscular fatigue in agricultural operation. Working posture, Work-rest schedule.

- Occupational exposure to environmental factors such as thermal, dust, chemical, noise and vibration. Health effects of environmental factors and reduction of exposure to agricultural workers
- Biomechanics and human motion, manual material handling, manual material handling hazards, musculoskeletal injuries and disorders.
- Quantitative and qualitative visual displays, signals and warning lights, warning signs and warning labels, vision at the workplace.

**Recommended Books:**

1. Fitting the Task to the Man, E. Grandjean, Taylor and Francis, London, 1988.
2. Human Factors in Engineering and Design, M.S. Sanders, and E.J. McCormick, McGraw Hill Inc., Singapore, 1978.
3. Hand Book of Human Vibration, M.J. Griffin, Elsevier Academic Press, London, 1996.

**AEMT505 Tractor System Design – II**

- Design of single point hitch. Design of three-point hitch systems: Parameters, virtual hitch point. Effect of hitch height on tractor performance with reference to hitch design. Weight transfer analysis.
- Hydraulic oil and their properties. Fluid contamination and control: Filters and coolers. Hydraulic symbols. Hydraulic reservoirs and accumulators. Seals, hoses and fittings
- Hydraulic pumps and actuators: Construction, sizing, selection, and efficiency. Hydraulic pressure, flow and direction control valve.
- Design of hydraulic circuits: Single and double action hydraulic cylinder, open and close centre, synchronizing, counterbalance, sequencing and fail safe. 9 lectures
- Tractor hydraulic system: Neutral, lowering and lifting mechanism. Draft, position and mixed control system. Hydraulic system maintenance, repair and reconditioning. Power steering.

**Recommended Books:**

1. Power Hydraulics, M.J. Pinches and J. Ashby, Prentice Hall International (UK) Ltd., New York, 1988.
2. Fluid Power with Applications, A. Esposito, Pearson Education Inc., 2003.
3. Off-Road Vehicle Engineering Principles, Carroll E. Goering, Marvin L. Stone, David W. Smith and Paul K. Turnquist, American Society of Agricultural Engineers, Michigan, 2003.

**AEMT506 Instrumentation for Agricultural Machines**

- Generalized configuration, structure and functional description of measuring instruments. Active and passive transducer, analogue and digital mode of operation, null and deflection method
- Performance characteristics of instruments including static and dynamic. Transfer function, signals and noise. Static and dynamic errors, and their statistical analysis
- Measuring devices for temperature, displacement, stress, strain, force, pressure, velocity, torque, acceleration, moisture content, noise, vibration etc.

- Signal conditioning elements: Deflection bridges, amplifiers etc. Signal processing elements and software: Analogue-to-digital (A/D) conversion, and digital-to-analogue conversion (D/A).
- Data acquisition, manipulating, compiling and compensating devices. Data transmission and recording. Telemetry.

**Recommended Books:**

1. Principles of Measurement Systems, J.P. Bentley, Pearson Education Limited, England, 2005.
2. Measurement Systems: Application and Design, E.O. Doebelin, McGraw Hill Co., New York, 1980.
3. Mechanical Measurements, T.G. Beckwith, N.L. Buck and R.D. Marangoni, Narosa Publishing House, New Delhi, 1982.
4. Instrumentation Measurement and Analysis, B.C. Nakra and K.K. Chaudhry, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1985.

**AEMT507 Testing and Evaluation of Tractors and Farm Equipment**

- Importance of testing, general regulations for testing, test terminologies. Types of test: Confidential, commercial and batch. Testing facilities in India and abroad for tractor and agricultural equipment. Test codes: OECD, Nebraska, ISO and BIS.
- Agricultural tractor power test: PTO performance test, test for engine, belt pulley test, and drawbar test.
- Test for hydraulic power, lifting capacity and maintenance of lift load. Air cleaner oil pull-over test, assessment of power drop and wear
- Safety test: Brake performance, CG location, turning ability and provisions of safety gadgets. Condition for correct steering. Ergonomic test: Noise measurement, mechanical vibration measurement, visibility from driver's seat, smoke level.
- Testing of various farm machines and their main components for functional performance, wear, strength, force, and power requirement.

**Recommended Books:**

1. BIS Test Codes IS:9253-1979, IS:5994-1979, IS:10743-1986, IS:4468-1986, IS:9545-1986, IS:9934-1986, IS:11442-1985, IS:4931-1986, IS:12062-1986, IS:10273-1986, IS:9253-1986, IS:5608-1986, IS:6460-1980, IS:6288-1971, IS:6635-1972, IS:6638-1972, IS:6813-1973, IS:8122-1981, IS:10233-1986, IS:6816-1986, IS:6284-1986.
2. RNAM Test codes and Procedures for Farm Machinery, 2<sup>nd</sup> Ed., United Nation International Development Organization, 1995.

**AEMT508 Alternative Sources of Energy**

- Renewable Energy Sources (RES): National and international scenario and different protocols. Criteria for assessing the potential of RES, classification of RES: Solar, wind, geothermal, biomass, ocean energy sources.
- Design of solar thermal devices. Natural and forced convection solar drying system. Solar PV system: Power generation and economic analysis. Solar pond: Working principle and design.

- Aerodynamics of wind power generation and wind resources assessment. Types of wind turbines: Working principle of horizontal and vertical axis wind turbines. Design of wind turbine blades. Performance assessment of wind turbines. Economic analysis of wind turbine generation
- Biomass and its resources: Assessment and characteristics. Biomass to thermal energy conversions – principles and technologies: Combustion, gasification and pyrolysis. Economic analysis of bio-energy conversion.
- Biomass – physical and biochemical conversion processes: Biogas, biodiesel and bioethanol. Types of different conversion technologies (transesterification, biochemical and anaerobic digestion) and their economic analysis.

**Recommended Books:**

1. Non-Conventional Sources of Energy, G. D. Rai, 4<sup>th</sup> Ed., Khanna Publishers, Delhi, 1996.
2. Non-Conventional Sources of Energy, O. P. Singhal, 1<sup>st</sup> Ed., Saroj Prakashan, Allahabad, 1996.
3. Solar Energy, S. P. Sukhatme, 2<sup>nd</sup> Ed., Tata McGraw Hill Publishing Co. Ltd. New Delhi, 1996.
4. Biotechnology, other Alternative Technologies for Utilization of Biomass/Agricultural Wastes, A. Chakraborty, 1<sup>st</sup>Ed., Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1989.

**AEMT509 Testing and Evaluation of Tractors and Farm Equipment Lab**

**AEMT601 Research Methodology and Proposal Writing:**

- Introduction to Research Methodology: Importance of Research in Decision Making, Defining Research Problem and Formulation of Hypothesis, Experimental Design.
- Data Collection and Measurement; Methods and Techniques of Data Collection, Sampling and sampling Designs, Data Presentation and Analysis; Data Processing.
- Attitude Measurement and Scales; Statistical Analysis and Interpretation of Data, Non-Parametric Tests, Multivariate analysis of Data.
- Measures of Central Tendency, Dispersion, Variation, Correlation, Regression, Model building and Decision Making.
- Report Writing and Presentation: Substance of Reports, formats of Reports, Presentation of Report.

**Recommended Books:**

1. Research Methodology, C.R. Kothari, New Age Publications, New Delhi,
2. Research Methodology, B. Taylor, G. Sinha and T. Ghoshal, Prentice Hall of India, New Delhi,
3. Research Methodology, R. Panneersalvam, Prentice Hall of India, New Delhi, 2007.
4. Management Research Methodology, K.N. Krishnaswamy, A.I. Sivakumar and M. Mathirajan, Pearson Education, New Delhi, 2008.

## **AEME501 Application of Programming in Farm Machinery Design and Management**

- Review of applications of computer programming in agriculture. Application of loops and decisions, structures, functions, objects and classes, arrays and strings, and pointers in computer programming.
- Solving the complex problems of agricultural machines using loops, functions and matrices. Use of data structures in computer programming.
- Visual basic.net: GUI design, controls, data handling, input and output operations, decision making. Microsoft excel: Data handling, analysis, and presentation using graphs and charts.
- Development of computer program for farm implements design and management, performance evaluation of tractor-implement combination and ballast management.
- Computer programming for performance evaluation of tractor trailer combination, implement matching.

### **Recommended Books:**

1. Let Us C, Yashwant, P. Kanetkar, Infinity Science Press, 2008.
2. Introduction to Programming with Visual Basic .NET, Gary J. Bronson and David Rosenthal, Jones and Bartlett Publishers, Boston, 2005.
3. Microsoft Excel Functions & Formulas, B. Held, Wordware Publishing, Inc., Massachusetts, 2007.

## **AEME502 Material Science and Engineering for Selection and Design of Farm Machines**

- Classification of engineering materials. Geometry of crystal: Space lattice, Space lattice and crystal structures. Determination of Crystal structure. Metallic bonding.
- Crystal imperfections and dislocations. Phase diagram and phase transformation. Fracture: Ductile and brittle fracture.
- Stress and strain in materials. plastic deformation; creep and mechanism of creep; elastic, inelastic and viscoelastic behavior; Oxidation and corrosion
- Mechanical property tests for materials: Destructive and non-destructive tests, tensile and compression test, shear test, fatigue test, hardness test, impact test.
- Non-metallic materials: Polymer, fibre, composite material, and ceramic materials; their types, properties, additives, and applications. Non-ferrous metals and their alloys. Use of metallic and non-metallic materials in construction of farm machinery.

### **Recommended Books:**

1. Material Science and Engineering – A first Course, V. Raghavan, 6<sup>th</sup> Ed., PHI Learning Pvt. Ltd., Delhi, 2015.
2. Introduction to Engineering Materials, B.K. Agrawal, Tata McGraw-Hill Education, Delhi, 1988.
3. Engineering Materials and Metallurgy, R.K. Rajput, 1<sup>st</sup> Ed., S. Chand & Co. Ltd., New Delhi, 2006.

## **AEME503 Principles of Mechanization and Management**

- Global review of farm mechanization. Mechanization and its stages. Mechanization and its link to development

- Selection of power units, machine capacity and field machinery management for stationary and mobile farm operation.
- Cost analysis of farm machinery: Valuation of machines. Identifying, monitoring and reducing machinery costs. Break-even analysis.
- Financing machinery, finance schemes and selection of appropriate scheme. Alternatives to ownership, contracting, hire schemes. Maintenance management. Machinery replacement.
- Analysis and organization of various operation management programmes. Inventory control of spare parts, work study, productivity, method study, use of computer in machinery management.

**Recommended Books:**

1. Farm Machinery Selection, Investment and Management, Resource Management Series, A. Landers, Farming Press, 2002.
2. Farm Power and Machinery Management, D. Hunt, Iowa State University Press, Ames, 2001.

**AEME504 Mechanization in Tea Production**

- Tea industry in India. Present status and economic importance. Cultivation of tea and equipment required for the mechanized cultivation.
- Drainage of water-logged soils, irrigation practices, pest management and weed control in tea plantation.
- Tea plucking: Time and motion studies on tea plucking. Chemistry of tea quality. Various manufacturing processes of black tea and green tea. Design of tea processing machines and selection of power sources.
- Tasting, blending, grading and sorting, packaging of tea. Instrumentation, monitoring and process control systems for critical manufacturing stages in Tea Industry.
- Transport and marketing, tea auction. Management of tea gardens and factory. Estate and worker productivity.

**Recommended Books:**

1. Tea Production and Processing, B. Banerjee, Oxford & IBH Publishing Co Pvt. Ltd., New Delhi, 2005.

**AEME505 Safety and Health in Agriculture:**

- Tractor hazards such as instability, runaway, power-take-off (PTO); machinery hazards; respiratory hazards in structure and environment; chemical and other hazards.
- Definition and causes of accident; severity of injury; effect of season, workplace, age, working time. Agricultural injury scenario in national and international level.
- Occupational safety and health principles in agriculture; Hazards and injury prevention and control: industrial safety and health approach, public health approach.
- Safety engineering principles; Hierarchy hazard control; roll over protective structure (ROPS); warning sign and warning labels; machine guarding.
- Provincial, national and international regulations and legislation for prevention of accidents; injury compensation.

**Recommended Books:**

1. Safety and Health for Production Agriculture, D.J. Murphy, ASAE publications, Michigan, 1992.

2. System Safety Engineering and Management, H.E. Roland and B. Moriarty, John Wiley and Sons Inc., New York, 1990.
3. Safety Engineering, James CoVan, Wiley, New York, 1995.

#### **AEME506 Statistical Methods in Agriculture:**

- Probability, random variable, discrete and continuous random variables and their probability distribution, distribution functions and their properties
- Conditional probability, independence of events, Bayes theorem, mathematical expectation, moments and moments generating function
- Tests of hypothesis for small and large sample sizes
- Methods of least squares, simple linear regression and correlation, multiple linear Regression
- Design and analysis of experiments: analysis of variance for one and two-way classified data, CRD, RBD and LSD

#### **Recommended Books:**

1. Fundamentals of Statistic, Vol. I and II, A.M. Groom, M.K. Gupta and B. Dasgupta, The Works Press Pvt. Ltd., Kolkata.
2. Introduction to Probability and Mathematical Statistics, V.K. Rohatgi, Wiley Eastern, New Delhi, 1976.
3. Experimental Design, W.G. Cochran and G.M. Cox, John Wiley and Sons, 1966.
4. Design and Analysis of Experiments, M.N. Das and J. Giri, Springer Verlag.

#### **AEME507 Earth Moving Machinery:**

- Types of earth moving machinery. Crawler tractor: Differential, brake, clutch, suspension, track-assembly, and their repair and maintenance.
- Principles of operation of bulldozer, front end loader, excavator, power shovels, etc. and their applications in agricultural operations
- Principles of operation of ditchers, scrapers, leveller, roller, grader and dump truck and their applications in agricultural operations.
- Boring machines and different methods of boring. Load hoisting equipment and their applications in agricultural operations
- Trouble shooting, repair and maintenance, cost of operation, and management of earth moving machines.

#### **Recommended Books:**

1. Land Reclamation Machinery, T. Borshchow, R. Mansurou and V. Sergeev, 1<sup>st</sup> Ed., MIR Publication, Moscow, 1988.
2. Manual of Tractor, J. Konrod, Asia Publishing House, London, 1968.
3. Motor Grader, E.G. Roninson, MIR Publication, Moscow, 1985.

#### **AEME601 Human Resources Management:**

- Theoretical foundations of HRM, HRD- an overview, Macro level manpower planning and Labour Market analysis, Organizational human resource planning (HRP).

- Market, Business, Competition and Strategy, HRD strategies, design and experience, Manpower inventory, Models and techniques of manpower Demand and Supply forecasting.
- Design of HR Systems for Competitive Advantage, HRD culture and climate, Behavioural factors in human resource planning-Wastage analysis, Retention, Redeployment, Exit strategies
- Career development, HRD climate and culture, QWL, Management of change. Managing Growth: People Agenda, Managing Change: People Agenda.
- HRM for Corporate Globalization, HR for Mergers, Acquisitions and Joint Ventures, Emerging trends and experiences, TQM and HRD strategies, Human resource information system (HRIS), Human resource valuation and Accounting (HRA).

**Recommended Books:**

1. Strategic Human Resource Development, T. Agarwala, FMS, Delhi University, New Delhi,
2. Strategic Human Resource Development - A Guide to Action, M. Armstrong, Kogan Page Publications, New Delhi,
3. HR: Development, Planning and Deployment, A.K. Sen, Asian Books Pvt. Ltd., New Delhi.

**AEME602 Bio-fuel Production and Application:**

- Biofuel: Introduction, sources and comparison of different types of biofuel. Solid, liquid and gaseous biofuels. Economics of different biofuel sources and comparative analysis with reference to fossil fuels.
- Biodiesel: Scope, sources, merits and demerits, cultivation practices of different sources of biodiesel. Physical and chemical properties of raw bio-diesel. Extraction, refining processes. Bioethanol: Sources, production process, merits and demerits
- Anaerobic digestion: Design and its uses.
- Biomass gasification: Pyrolysis, design theory and modelling of gasifier.
- Performance of engine with different types of bio-fuels, exhaust and impact on environment.

**Recommended Books:**

1. Bio-diesel: Basics and Beyond: A comprehensive guide to production and use for Home and Farm, William H. Kemp, New Society Publishing, Canada, 2006.
2. Biodiesel Production Technologies, S.K. Mehta, Eastern Book Corporation, New Delhi, 2007.
3. Biofuels: Production, Application and Development, A.H. Scragg, CAB International, London, 2009.
4. Biomass Gasification and Pyrolysis: Practical Design and Theory, P. Basu, Elsevier Academic press, London, 2010.

**AEME603 Computerized Design of Agricultural Machines:**

- Introduction to AutoCAD: Screen components, invoking commands, dialog boxes, saving, closing and managing workspaces
- Coordinate systems, object selection methods, setting units type and precision. Dimension: Fundamental dimensioning terms, creating linear, angular, inspection and associative dimensions.

- Drawing different two-dimensional objects. Hatching patterns, editing sketched objects. Creating text and tables: Annotative objects, creating and editing text, inserting table in the drawing
- Solid modelling: Creation of three-dimensional machine components using Solid works. Geometric dimensioning and tolerance: Characteristics and symbols used.
- Digital human modelling: Use of percentile anthropometric and biomechanical data for agricultural tools and equipment design, techniques/ process of virtual ergonomics evaluation using DHMs,

**Recommended Books/ Study materials:**

1. Mastering AutoCAD 2016 and AutoCAD LT, Brian C. Benton and George Omura, Autodesk Official Press, 2016.
2. Engineering Drawing and Graphics Using AutoCAD, T. Jeyapoovan, 3<sup>rd</sup> Ed.,Vikas Publishing House Pvt Limited, New Delhi, 2010.
3. SolidWorks2016 Reference Guide, D. Planchard, SDC Publications, 2016.
4. Handbook of Digital Human Modelling, V.G. Duffy, CRC Press, Boca Raton, Florida, 2008.

**AEME604 Precision Agricultural Machinery:**

- Basics of precision agriculture, tools for implementation of precision agriculture. Information Technology. Spatial location, GPS, computer vision systems, information acquisition.
- Site-specific nutrient management, data sources and decision making for site-specific nutrient management. Economic, ecological and social impacts of site-specific nutrient management. Grain quality and yield.
- Site-specific weed management, weed distribution, stability of weed populations, weed monitoring and control. Site-specific herbicide application. Agro-chemicals and fertilisers, patch spraying.
- Use of microprocessor-based systems and computer in precision agriculture, Automation.
- Crop yield monitors. Decision support systems; artificial intelligence. Remote sensing
- for precision agriculture. Field plot machines.

**Recommended Books:**

1. The Precision Farming Guide for Agriculturists, D. Ess, M. Morgan, and R. Reynolds, John Deere Publishing. USA,1997.
2. Precision Agriculture for Grain Production Systems, B. Whelan and J. Taylor, Csiro Publishing, Collingwood, Australia, 2013.
3. Precision Agriculture Technology for Crop Farming, Q. Zhang, CRC Press, Boca Raton, Florida, 2016.

**AEME605 Project Management:**

- Definition of Project, Need of Project Management, Project Development Cycle, Project Planning, Project Environment analysis, Project Report Preparation; Preliminary Screening, and Feasibility Report preparation and analysis

- Project Evaluation; Market and Demand analysis, Demand Forecasting, Technical, Financial, Socio-economic, Environmental and Entrepreneurial analyses of project, Project Selection Criteria, Project Implementation.
- Resource Planning and Allocation, Estimation of Project Cost, Cost of Capital, Means of Finance, Working Capital requirement, Profitability projection, Cash Flow Analysis, Breakeven analysis.
- Financial Analysis, Financial Statements, Balance Sheet, Ratio Analysis, Depreciation of Fixed Assets, Social Benefit-Cost Analysis
- Project Review Techniques, Network Technique, Programme Evaluation Review Technique (PERT), Network scheduling, CPM, Activity scheduling, Time-cost trade-offs

**Recommended Books:**

1. Project Management, R. Panneerselvam and P. Senthilkumar, PHI, New Delhi, 2009.
2. Project Management for Business and Technology, J.M. Nicholas, Pearson Education, New Delhi, 2009.
3. Project Formulation, Implementation and Appraisal, P. Chandra, Tata McGraw-Hill, New Delhi, 2006.
4. Financial Management, P. Chandra, Tata McGraw-Hills Publishing Co. Ltd., New Delhi,
5. Project Management, H. Kerzner, CBS Publisher and Distributor, New Delhi, 2004.

**AEME606 Industrial Safety:**

- Definition and classification of hazards. Hazardous materials: Classification, characteristics, means of exposure and health effect, disposal. Hazard information label, safety precautions
- Explosive and flammable materials: Types, classification, characteristics, safety signs, material handling. Engineering and administrative safety control
- Fire safety: Causes, safety concept, extinction methods, and fire-fighting equipment. Building safety: means of escape, evacuation strategies and procedure, fire and smoke prevention.
- Electrical hazards: Causes and types of electrical injuries, general electrical safety rules, PPE. Welding: Types, health hazards of welding, reducing hazards of welding
- Hazard communication, medical surveillance, safety legislation, safety management

**Recommended Books:**

1. Introduction to Fire Safety Management, A. Furness and M. Muckett, Butterworth-Heinemann, Oxford, 2010.
2. System Safety Engineering and Management, H. E. Roland and B. Moriarty, John Wiley and Sons Inc., New York, 1990.
3. Safety Engineering, James CoVan, Wiley, New York, 1995.