CURRICULUM
OF
AGRICULTURAL ENGINEERING

M. Tech. (Agricultural Engineering)
Specialization: Farm Machinery and Power Engineering

M. Tech. (Agricultural Engineering)
Specialization: Farm Machinery and Power Engineering
Course Structure

Semester I

Sl. No	Course Code	Course Name	Teaching Scheme L	T	P	Credits
1.	MAE3 101	Design and Testing of Farm Power Systems	3	0	0	3
2.	MAE3 102	Soil Dynamics in Tillage and Traction	3	0	0	3
3.	MAE3 Axx	Programme Elective – I	3	0	0	3
4.	MAE3 Bxx	Programme Elective - II	3	0	0	3
5.	MASH 101	Research Methodology & IPR	2	0	0	2
6.	MASH 1xx	Audit Course - 1	2	0	0	0
7.	MAE3 103	Farm Power Design and Testing Lab.	0	0	4	2
8.	MAE3 104	Soil Dynamics Lab.	0	0	4	2
		Total	**16**	**0**	**8**	**18**

Semester II

Sl. No	Course Code	Course Name	Teaching Scheme L	T	P	Credits
1.	MAE3 201	Design and Testing of Farm Machinery Systems	3	0	0	3
2.	MAE3 202	Recent Advances in Farm Machinery and Power Engineering	3	0	0	3
3.	MAE3 Cxx	Programme Elective - III	3	0	0	3
4.	MAE3 Dxx	Programme Elective – IV	3	0	0	3
5.	MASH 2xx	Audit Course - 2	2	0	0	0
6.	MAE3 203	Farm Machinery Design and Testing Lab.	0	0	4	2
7.	MAE3 204	Advanced Farm Machinery and Power Lab.	0	0	4	2
8.	MAE3 205	Mini Project	0	0	4	2
		Total	**14**	**0**	**12**	**18**

Semester III

Sl. No	Course Code	Course Name	Teaching Scheme L	T	P	Credits
1.	MAE3 Exx	Programme Elective – V	3	0	0	3
2.	MASH Axx	Open Elective	3	0	0	3
3.	MAE3 301	Dissertation Phase - I	0	0	20	10
		Total	**6**	**0**	**20**	**16**

Semester IV

Sl. No	Course Code	Course Name	Teaching Scheme L	T	P	Credits
1.	MAE3 401	Dissertation Phase - II	0	0	32	16
		Total	**0**	**0**	**32**	**16**

Programme Elective – I

MAE3 A01 System Simulation and Computer Aided Problem Solving in Engineering
MAE3 A02 Computer Programming and Application in Engineering
MAE3 A03 Computerized Design of Agricultural Machines

Programme Elective – II

MAE3 B01 Instrumentation and Research Techniques
MAE3 B02 Machinery System for Precision Agriculture
MAE3 B03 Experimental and Whole Field Stress Analysis

Programme Elective – III

MAE3 C01 Renewable Sources of Energy and Utilization
MAE3 C02 Energy Conservation and Management
MAE3 C03 Design of Solar and Wind Systems

Programme Elective – IV

MAE3 D01 Hydraulic System and Control
MAE3 D02 Fluid Power System and Automation
MAE3 D03 Land Reclamation Machinery

Programme Elective – V

MAE3 E01 Human Factors Engineering in the Design of Tractor and Farm Machinery
MAE3 E02 Finite and Boundary Element Methods in Engineering
MAE3 E03 Principles of Mechanization and Management

Audit Course 1 & 2

MASH 102 English for Research Paper Writing
MASH 103 Disaster Management
MASH 104 Sanskrit for Technical Knowledge
MASH 105 Value Education
MASH 201 Constitution of India
MASH 202 Pedagogy Studies
MASH 203 Stress Management by Yoga
MASH 204 Personality Development through Life Enlightenment Skills.

Open Elective Courses

MASH A01 Business Analytics
MASH A02 Industrial Safety
MASH A03 Operations Research
MASH A04 Cost Management of Engineering Projects
MASH A05 Composite Materials
MASH A06 Waste to Energy

CORE COURSES

MAE3 101, Design and Testing of Farm Power Systems

Teaching Scheme

Lectures: 3 hours/week

Course Outcomes

At the end of this course, students will be able to

- Understand the recent trends, design and construction of farm power systems
- Apply the design principles for the design and development engine and tractor systems.
- Demonstrate the procedure for testing of farm power systems.

Syllabus Contents

Unit 1: Technical specifications of tractors available in India, modern trends in tractor design and development, special design features of tractors in relation to Indian agriculture. Engineering thermodynamics, power cycles, fuels, various systems of I.C engines, operations, adjustments and trouble shooting of different systems, calculations of power, torque, speed, firing arrangement and intervals, heat loss and power transmission from piston to the flywheel.

Unit 2: Parameters affecting design of tractor engine and their selection. Design of fuel efficient engine components and transmission, differential, final drives, power outlets such as PTO and drawbar.

Unit 3: Engine performance, design of clutch, gear box and power transmission system to wheels.

Unit 4: Recent trends in tractor design, emissions and control of pollutants, Design of mechanical steering and brake system of tractor, hydraulic brake system, Steering geometry and stability during turning.

Unit 5: Measurement of tractor engine power, torque, fuel consumption, draft and drawbar power, Engine and tractor performance testing, evaluation and interpretation of results.

References

1. Liljedahl, J.B.,Turnquist, P.K., Smith, D.W. and Hoki, M. 2004. Tractors and their Power Units, 4th Edition. CBS Publishers & Distributors, New Delhi.
2. Mathur, M.L. and Sharma, R.P. 2014. Internal Combustion Engines. Dhanpat Rai Publications (P) Lrd., New Delhi.
3. Goering, C.E. and Hansen, A.C. 2013.Engine and Tractor Power. ASABE, USA.
4. Sharma, D.N. and Mukesh, S. 2018. Design of Agricultural Tractor (Principles and Problems), 3rd Edition. Jain Brothers, New Delhi.

MAE3 102, Soil Dynamics in Tillage and Traction

Teaching Scheme

Lectures: 3 hours/week

Course Outcomes

At the end of this course, students will be able to

- Understand the measurement of dynamic properties of soil and evaluate the performance tillage tools and traction devices.
- Apply the dynamic properties of soil to the design of tillage tools and selection of traction devices.
- Understand the relationship between soil-tillage tool and soil-traction device interactions along with operating parameters.

Syllabus Contents

Unit 1: Dynamic properties of soil and their measurement, stress-strain relationships, theory of soil failure.

Unit 2: Mechanics of tillage tools and geometry of soil tool system, design parameters and performance of tillage tools. Dimensional soil tool system, design parameters and performance of tillage tools.

Unit 3: Dimensional analysis of different variables related to soil-tyre system; soil vehicle models; mechanics of steering of farm tractor; special problems of wet land traction and floatation.

Unit 4: Introduction of traction devices, tyres-types, function and size, their selection; mechanics of traction devices. Deflection between traction devices and soil, slippage and sinkage of wheels, evaluation and prediction of traction performance, design of traction and transport devices. Soil compaction by agricultural vehicles and machines.

Unit 5: Recent advances in soil dynamics in tillage and traction, impact of recent research on vehicle design.

References

1. Gill, W.R. and Vandenberg, G.E. 1968. Soil Dynamics in Tillage and Traction. Agricultural Research Service, US Dept. of Agriculture, Washington, D.C., USA.
2. Upadhyaya, S.K. 2013.Advances in Soil Dynamics. ASABE, St. Joseph, USA.
3. Wong, J.Y. 2010. Terramechanics and Off-road Vehicle Engineering. Elsevier, New York.
4. Srivastava, A.K., Goering, C.E., Rohrbach, R.P. and Buckmaster, D.R. 2013.Engineering Principles of Agricultural Machines, 2nd Edition. ASABE, St. Joseph, USA.

MAE3 103, Farm Power Design and Testing Lab.

Teaching Scheme

Lectures: 4 hours/week

Course Outcomes

At the end of this course, students will be able to

- Design various engine components and tractor systems
- Demonstrate the testing of engine and tractor according to the standards.
- Evaluate the performance of tractor and power tiller under actual field conditions.

Syllabus Contents

The lab practice consists of the tutorials and experiments as decided by the course supervisor of the course, Design and Testing of Farm Power Systems. It includes but not restricted to the following:

Mechanical design of engine components.

Design of clutch system.

Design of gear box for tractor and power tiller.

Design of differential and final drive.

Design considerations of brake and steering system of tractor.

Testing of engines and power units.

Drawbar performance evaluation of tractor and power tillers.

Design of Safety devices for tractors and farm implements.

References

1. Liljedahl, J.B.,Turnquist, P.K., Smith, D.W. and Hoki, M. 2004. Tractors and their Power Units, 4th Edition. CBS Publishers & Distributors, New Delhi.

2. Goering, C.E. and Hansen, A.C. 2013.Engine and Tractor Power. ASABE, USA.
3. Sharma, D.N. and Mukesh, S. 2018. Design of Agricultural Tractor (Principles and Problems), 3rd Edition. Jain Brothers, New Delhi.
4. MacMillan, R.H. 2002. Mechanics of Tractor Implement Performance. University of Melbourne.

MAE3 104, Soil Dynamics Lab.

Teaching Scheme

Lectures: 4 hours/week

Course Outcomes

At the end of this course, students will be able to

- Measure the dynamic properties of soil and evaluate the performance tillage tools and traction devices.
- Design of tillage tools and selection of traction devices based in dynamic properties of soil
- Apply the traction prediction equation for the performance of traction devices.

Syllabus Contents

The lab practice consists of the tutorials and experiments as decided by the course supervisor of the course, Soil Dynamics in Tillage and Traction. It includes but not restricted to the following:
Determination of dynamic properties of soil.
Relationship of soil parameters to the forces acting on tillage tools
Determination of wheel slippage
Design and performance of traction devices
Design and performance of soil working tools.
Deflection and contact characteristics of tyres.
Determination of tractive effort and slip of tractor tyres.
Evaluation and prediction of traction performance.

References

1. Gill, W.R. and Vandenberg, G.E. 1968. Soil Dynamics in Tillage and Traction. Agricultural Research Service, US Dept. of Agriculture, Washington, D.C., USA.
2. Upadhyaya, S.K. 2013.Advances in Soil Dynamics. ASABE, St. Joseph, USA.
3. Wong, J.Y. 2010. Terramechanics and Off-road Vehicle Engineering. Elsevier, New York.
4. Srivastava, A.K., Goering, C.E., Rohrbach, R.P. and Buckmaster, D.R. 2013.Engineering Principles of Agricultural Machines, 2nd Edition. ASABE, St. Joseph, USA.

MAE3 201, Design and Testing of Farm Machinery Systems

Teaching Scheme

Lectures: 3 hours/week

Course Outcomes

At the end of this course, students will be able to

- Understand the design principles and dynamics of various farm machinery, and apply them to design and construction of farm machinery.
- Design and develop appropriate machinery for various applications.
- Evaluate the performance of farm machinery under actual field conditions.

Syllabus Contents

Unit 1: Modern trends, principles, procedures, fundamentals and economic considerations for design and development of farm power and machinery systems. Design considerations,

procedure and their applications in agricultural tractors and typical machines. Reliability criteria in design and its application, Status of farm mechanization in India, power availability on farms. Hand tools used for different kinds of farm operations and materials for construction.

Unit 2: Functional requirement, principle of working, construction features and operations of animal and power operated equipment for land development, tillage, sowing, planting, transplanting, fertilizer application, intercultivation, plant protection, Theory of atomization, specific energy for atomization, electrostatic spraying and dusting, spray distribution patterns.

Unit 3: Design and selection of machinery elements viz. gears, pulleys, chain and sprockets, belts, bearings couplings and springs and fasteners. Farm machine system characteristics and evaluation, dynamic balancing and stability of farm machines. Force analysis of agricultural tools and implements, pull, draft and power of farm equipment.

Unit 4: Design of soil working tools for sowing and planting. Design of seed drill, planter, fertilizer applicators, intercultivation equipment and plant protection equipment. Design of rotary, vibratory and oscillating machines.

Unit 5: Types of tests; test procedure, national and international codes. Test equipment, usage and limitations. Power losses in dynamometers and hydraulic test equipment. Prototype feasibility testing and field evaluation. Laboratory and field testing of selected farm equipment.

References

1. Bernacki, H., Haman, J. and Kanafojski, Cz. 1972. Agricultural Machines: Theory and Construction. U.S. Dept. of Commerce, National Technical Information Service, Springfield, Virginia.
2. Kepner, R.A., Bainer, R. and Berger, E.L. 1978. Principles of Farm Machinery. John Wiley and Sons, New York.
3. Srivastava, A.K., Goering, C.E., Rohrbach, R.P. and Buckmaster, D.R. 2013.Engineering Principles of Agricultural Machines, 2nd Edition. ASABE, St. Joseph, USA.
4. Singh, T.P. 2017. Farm Machinery. PHI Learning Pvt. Ltd., Delhi.
5. Singh, S. 2007. Farm Machinery Principles and Applications. ICAR, New Delhi.
6. Sharma, D.N. and Mukesh, S. 2008. Farm Machinery Design: Principles and Problems, 3rd Edition. Jain Brothers, New Delhi.

MAE3 202, Recent Advances in Farm Machinery and Power Engineering

Teaching Scheme

Lectures: 3 hours/week

Course Outcomes

At the end of this course, students will be able to

- Understand the kinematics and dynamics of various farm power and machinery systems.
- Apply the principles of ergonomics in the design of farm power and machinery systems.
- Develop precision agricultural system, and hydraulic system and control for the design of farm machinery.

Syllabus Contents

Unit 1: Kinematics of reapers/harvesting machines. Theory of mechanical separation of grains from ear heads/pods. Parameters affecting performance of threshers aerodynamic properties of straw and grain mixture, Design consideration and constructional features of harvesting, threshing, mowing, chaff cutting and baling machines, Testing of harvesters, threshers, combines, mowers, chaff cutting and baling machines.

Unit 2: Theory of root crop harvesters, power requirement of various components of field

machines. Design consideration and constructional features of special equipment for crops such as sugarcane, cotton, groundnut, potato and plantation crops like coconut, areca nut, cashew nut etc. Recent trends in the design and testing of tractor and farm machinery, Emissions and control of pollutants, Mechanical noise and vibrations and their reduction, Farm machinery management.

Unit 3: Hydraulic system circuits, design and selection of hydraulic system components, automatic draft and position control system. Hydrostatic transmission, Power steering, Design of pneumatic and hydraulic controls, Working principle and operation of land reclamation machinery.

Unit 4: Tractor chassis mechanics, hitching systems, 3-point hitch linkage design, hydraulic control of tractors, Determination of CG and moment of inertia, Dynamic stability and tractive ability of tractor, Tire selection.

Unit 5: Ergonomics in tractor system design, noise and vibration effects, Design of operators' seat and suspension, work-place area and controls, Strain gauges and instruments for the measurement of tractor engine power, torque, fuel consumption, draft and drawbar power, Precision agriculture, sensors, GPS, GIS, Variable rate applications.

References

1. Srivastava, A.K., Goering, C.E., Rohrbach, R.P. and Buckmaster, D.R. 2013. Engineering Principles of Agricultural Machines, 2nd Edition. ASABE, St. Joseph, USA.
2. Kepner, R.A., Bainer, R. and Berger, E.L. 1978. Principles of Farm Machinery. John Wiley and Sons, New York.
3. Singh, T.P. 2017. Farm Machinery. PHI Learning Pvt. Ltd., Delhi.
4. Singh, S. 2007. Farm Machinery Principles and Applications. ICAR, New Delhi.
5. MacMillan, R.H. 2002. Mechanics of Tractor Implement Performance. University of Melbourne.
6. Bernacki, H., Haman, J. and Kanafojski, Cz. 1972. Agricultural Machines: Theory and Construction. U.S. Dept. of Commerce, National Technical Information Service, Springfield, Virginia.
7. Liljedahl, J.B.,Turnquist, P.K., Smith, D.W. and Hoki, M. 2004. Tractors and their Power Units, 4th Edition. CBS Publishers & Distributors, New Delhi.

MAE3 203, Farm Machinery Design and Testing Lab.

Teaching Scheme

Lectures: 4 hours/week

Course Outcomes

At the end of this course, students will be able to

- Demonstrate the design of farm machinery for various farm operations.
- Design, develop and evaluate the performance of the farm machines for various applications.
- Select the appropriate power source and design the machinery matching to the power source.

Syllabus Contents

The lab practice consists of the tutorials and experiments as decided by the course supervisor of the course, Design and Testing of Farm Machinery Systems. It includes but not restricted to the following:

Design of mechanisms and prototypes in farm machinery.

Calibration of seed drills and planters.

Calibration of plant protection equipments.
Design of animal and power operated equipment for land development and tillage.
Design of animal and power operated equipment for sowing, planting, transplanting, fertilizer application and intercultivation
Design of plant protection equipment.
Methods of testing and performance evaluation of tillage equipments
Methods of testing and performance evaluation of seed drills, planters and fertilizer applicators
Design of rotary, vibrating and oscillating machines.
Methods of testing and performance evaluation of sprayers and dusters
Design and selection of matching power unit.
Cost analysis of animal and tractor operated implements and tractors.

References

1. Bernacki, H., Haman, J. and Kanafojski, Cz. 1972. Agricultural Machines: Theory and Construction. U.S. Dept. of Commerce, National Technical Information Service, Springfield, Virginia.
2. Singh, T.P. 2017. Farm Machinery. PHI Learning Pvt. Ltd., Delhi.
3. Singh, S. 2007. Farm Machinery Principles and Applications. ICAR, New Delhi.
4. Srivastava, A.K., Goering, C.E., Rohrbach, R.P. and Buckmaster, D.R. 2013. Engineering Principles of Agricultural Machines, 2nd Edition. ASABE, St. Joseph, USA.

MAE3 204, Advanced Farm Machinery and Power Lab.

Teaching Scheme

Lectures: 4 hours/week

Course Outcomes

At the end of this course, students will be able to

- Design and evaluate the performance of harvesting, threshing and special equipment for various farm operations.
- Understand the principles of farm machinery management for different soil, crops and operations.
- Apply the principles of hydraulics, kinematics and dynamics for the design and development of farm machines.

Syllabus Contents

The lab practice consists of the tutorials and experiments as decided by the course supervisor of the course, Recent advances in Farm Machinery and Power Engineering. It includes but not restricted to the following:
Design of harvesting and threshing equipment.
Design of special equipment for sugarcane, cotton, rice and potato crops.
Methods of testing and performance evaluation of harvesting equipment.
Methods of testing and performance evaluation threshing equipment.
Methods of testing and performance evaluation grain and straw combines.
Methods of testing and performance evaluation of special equipment such as sugarcane, cotton, rice and potato planter.
Calculation of field capacity, efficiency and losses in threshers, harvesters and chaff cutters.
Farm machinery selection and management for different soil, crops and operations.
Design of hydraulic system components.
Kinematic and dynamic design of 3-point hitch linkages.

Determination of CG and moment of inertia of tractor.
Estimation of energy and power requirements.
Reliability of farm machinery.

References

1. Bernacki, H., Haman, J. and Kanafojski, Cz. 1972. Agricultural Machines: Theory and Construction. U.S. Dept. of Commerce, National Technical Information Service, Springfield, Virginia.
2. Singh, T.P. 2017. Farm Machinery. PHI Learning Pvt. Ltd., Delhi.
3. Singh, S. 2007. Farm Machinery Principles and Applications. ICAR, New Delhi.
4. Srivastava, A.K., Goering, C.E., Rohrbach, R.P. and Buckmaster, D.R. 2013. Engineering Principles of Agricultural Machines, 2nd Edition. ASABE, St. Joseph, USA.
5. MacMillan, R.H. 2002. Mechanics of Tractor Implement Performance. University of Melbourne.

MAE3 205, Mini Project

Teaching Scheme

Lectures: 4 hours/week

Course Outcomes

At the end of this course,

- Students will solve a live problem using software/analytical/computational tools.
- Students will learn to write technical reports.
- Students will develop skills to present and defend their work in front of technically qualified audience.

Syllabus Contents

Students can take up small problems in the field of design and development or design refinement of farm machines or computer application in tractor and farm machinery design as mini project. It can be related to solution to an engineering problem, verification and analysis of experimental data available, comparative performance of various farm equipment, conducting experiments on various engineering subjects, studying a software tool for the solution of an engineering problem etc.

MAE3 301, Dissertation Phase - I

Teaching Scheme

Lectures: 20 hours/week

Course Outcomes

At the end of this course,

- Students will be exposed to self-learning various topics.
- Students will learn to survey the literature such as books, national/international refereed journals and contact resource persons for the selected topic of research.
- Students will learn to write technical reports.
- Students will develop oral and written communication skills to present and defend their work in front of technically qualified audience.

Guidelines

The Project Work will start in semester III and should preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution. Seminar

should be based on the area in which the candidate has undertaken the dissertation work as per the common instructions for all branches of M. Tech. The examination shall consist of the preparation of report consisting of a detailed problem statement and a literature review. The preliminary results (if available) of the problem may also be discussed in the report. The work has to be presented in front of the examiners panel set by Head and PG coordinator. The candidate has to be in regular contact with his guide and the topic of dissertation must be mutually decided by the guide and student.

MAE3 401, Dissertation Phase - II

Teaching Scheme

Lectures: 32 hours/week

Course Outcomes

At the end of this course,

- Students will be able to use different experimental techniques.
- Students will be able to use different software/ computational/analytical tools.
- Students will be able to design and develop an experimental set up/ equipment/test rig.
- Students will be able to conduct tests on existing set ups/equipments and draw logical conclusions from the results after analyzing them.
- Students will be able to either work in a research environment or in an industrial environment.
- Students will be conversant with technical report writing.
- Students will be able to present and convince their topic of study to the engineering community.

Guidelines

It is a continuation of Project work started in semester III. He has to submit the report in prescribed format and also present a seminar. The dissertation should be presented in standard format as provided by the department. The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion. The report must bring out the conclusions of the work and future scope for the study. The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner and a guide, co-guide etc. as decided by the Head and PG coordinator. The candidate has to be in regular contact with his guide.

PROGRAMME ELECTIVES – I

MAE3 A01, System Simulation and Computer Aided Problem Solving in Engineering

Teaching Scheme

Lectures: 3 hours/week

Course Outcomes

At the end of this course,

- Understand the concept of dimensional analysis, mathematical modeling and software development process in solving the engineering problems related to design of farm machinery
- Apply the knowledge of CAD software in solving the engineering problems related to design of farm machinery
- Understand the application of soft computing techniques for the modeling and optimization of design of farm machinery.

Syllabus Contents

Unit 1: Concept, advantages and limitation of dimensional analysis, dimensions and units, fundamental and derived units, systems of units, conversion of units of measurement, conversion of dimensional constants, conversion of equations in different units, complete set of dimensionless products and their formulation methods- the Rayleigh's method, Buckingham's Pi theorem and other methods.

Unit 2: Mathematical modeling and engineering problem solving, Introduction to simulation, Simulation of Mechanical systems and visualization, Classification and regression modelling of biological systems using fuzzy logic and artificial neural networks.

Unit 3: Computers and softwares – software development process – Algorithm design, – program composition- quality control- documentation and maintenance – software strategy.

Unit 4: Approximation- round off errors- truncation errors. Nature of simulation systems models and simulation- discreet event simulation- time advance mechanisms- components of discreet event simulation model. Simulation of singular server que- programme organization and logic-development of algorithm.

Unit 5: Solving differential equation on computers- modeling engineering systems with ordinary differential equations- solution techniques using computers, Optimization in mechanical and biological systems using nature-inspired techniques.

References

1. Law, A.M. and Kelton, W.D. 1997. Simulation Modeling and Analysis, 3rd Edition. Tata McGraw Hill Education, New Delhi.
2. Balagurusamy, E. 2000. Numerical Methods. Tata McGraw Hill Education, New Delhi.
3. Langhaar, H.L. 1980. Dimensional analysis and theory of models. Krieger Pub. Co., New York.
4. Veerarajan, T. and Ramachnadran, T. 2004. Numerical Methods with Programmes in C and C++. Tata McGraw Hill, New Delhi
5. Rattan, S.S. 2009. Theory of Machines, 4th Edition, McGraw Hill Publishing, New Delhi
6. Pratihar, D.K. 2008. Soft Computing, 2nd Edition. Kartar Publication House Pvt. Ltd., New Delhi.
7. Jang, J.S.R., Sun, C.T. and Mizutani, E. 2002. Neuro - Fuzzy and Soft Computing: Computational Approach to Learning and Machine Intelligence. Prentice Hall India Learning Pvt. Ltd., New Delhi.

8. Rajasekaran, S. and Pai, G.A.V. 2003. Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis and Applications. Prentice Hall India Learning Pvt. Ltd., New Delhi

MAE3 A02, Computer Programming and Application in Engineering

Teaching Scheme

Lectures: 3 hours/week

Course Outcomes

At the end of this course, students will be able to

- Write the computer program in C and MATLAB for various applications.
- Understand the iterative techniques and numerical analysis with programming.
- Apply the programming in the design and simulation of farm machinery and power systems.

Syllabus Contents

Unit 1: C-programming, arrays, pointers and structures.

Unit 2: MATLAB programming, 2-D and 3-D plotting, Simulation programming in MATLAB.

Unit 3: Computational algorithms and computer arithmetic. Iterative methods and solution to polynomial and simultaneous non-linear equations. Solution to simultaneous algebraic equations.

Unit 4:. Interpolation, Least square approximation of functions, Taylor series representation, Chebyshev series.

Unit 5: Differentiation and integration, Simpson's rule, numerical solution for differential equations.

References

1. King, K.N. 1996. C Programming: A Modern Approach, 1st Edition. W.W. Norton & Co. Inc., New York.
2. Chapman, S.J. 2007. MATLAB Programming for Engineers. Thomson Learning, London.
3. Steffensen, J.F. 2006. Interpolation: Second Edition (Dover Books on Mathematics), Dover Publications, New York.
4. Mircea, V. 2012. Computer Arithmetic: Algorithms and Hardware Implementations. Springer-Verlag Berlin Heidelberg, New Jersy.
5. Atkinson, K., Han, W. and Stewart, D. 2009. Numerical Solution of Ordinary Differential Equations. John Wiley & Sons, Inc., New Jersy.

MAE3 A03, Computerized Design of Agricultural Machines

Teaching Scheme

Lectures: 3 hours/week

Course Outcomes

At the end of this course, students will be able to

- Develop the solid model and simulate the working of various machine elements.
- Apply the advanced techniques of stress analysis for the mechanical design of machine elements.
- Understand the design of machine elements from mechanical production considerations.

Syllabus Contents

Unit 1:. Hardware, graphs and charts, two-dimensional transformations, lines, circles, ellipses and polygons. Storage of graphical data, animation, two-dimensional geometric construction techniques, user interface techniques.

Unit 2:. Introduction to three-dimensional graphics, three-dimensional transformations, surfaces,

shading. Solid and wire frame modeling of machine components.
Unit 3:.Graphical techniques in finite element analysis. Interfacing data between CAD and CAM applications, Concurrent engineering.
Unit 4:. Introduction to manufacturing, part design specifications, computer-aided design. Automation, programmable logic controllers, fundamentals of numerical control, numerical-control programming, group technology, process planning.
Unit 5: Integrated computer-aided manufacturing. Planning of manufacturing process.
References

1. Alavala, C.R. 2008. CAD/CAM: Concepts and Applications. PHI Learning, New Delhi.
2. Kundra, T.K. 1993. Computer Aided Manufacturing. Tata McGraw-Hill Education, New Delhi.
3. Sarcar, M.M.M., Rao, K.M. and Narayan, K.L. 2008. Computer Aided Design and Manufacturing. PHI Learning Pvt. Ltd., New Delhi.
4. Xu, X. 2009. Integrating Advanced Computer-Aided Design, Manufacturing, and Numerical Control : Principles and Implementation. Information Science Reference.

PROGRAMME ELECTIVES – II

MAE3 B01, Instrumentation and Research Techniques

Teaching Scheme
Lectures: 3 hours/week
Course Outcomes
At the end of this course, students will be able to

- Understand the working principle of instruments for the measurement of various parameters.
- Develop the instrumentation system for specific applications.
- Design the experiments, analyze the data and report the outcome of experiment

Syllabus Contents
Unit 1:. Generalized configuration, functional description and performance characteristics of measuring instruments. Errors in measurement and their statistical analysis.
Unit 2: Measuring devices for moisture content, humidity, temperature, flow, force, torque, power, pressure, stress, strain, displacement, velocity, acceleration, noise and vibration.
Unit 3: Data manipulating, compiling and compensating devices. Data transmission and recording.
Unit 4: Dimensional analysis, design of experiments – RBD and factorial design. Developing empirical models, correlation and regression, rectification techniques
Unit 5: Statistical data analysis using software and interpretation of data, Presentation of data, Report writing.
References

1. Rajput, R.K. 2005. Mechanical Measurements and Instrumentation (Including Metrology and Control Systems). S.K. Kataria & Sons, New Delhi.
2. Northrop, R.B. 2005. Introduction to Instruments and Measurement, 2nd Edition. CRC Press, Taylor and Francis Group, New York.
3. Peter Bock. 2001. Getting it Right: R & D Methods for Science and Engineering. Academic Press, New Delhi.
4. Kothari, C.R. 2004. Research Methodology: Methods and Techniques. New Age International (P) Ltd., New Delhi.

MAE3 B02, Machinery System for Precision Agriculture

Teaching Scheme

Lectures: 3 hours/week

Course Outcomes

At the end of this course, students will be able to

- Understand the concept of precision agriculture and implements for precision agricultural machinery.
- Design the farm implements for precise application of farm inputs.
- Develop decision support system and apply computer and electronics to the design of precision agricultural machines.

Syllabus Contents

Unit 1: Basics of precision agriculture, tools for implementation of precision agriculture. Information Technology. Spatial location, GPS, Information acquisition. Functional design, specifications, requirements and working of farm machinery needed for precision sowing and planting, laser guided leveller, power sprayer, straw chopper cum spreader, straw bailer, combine harvester etc.

Unit 2: 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. Yield monitoring and mapping, soil sampling and analysis. Role of electronics in farm machinery for precision farming.

Unit 3: Site-specific weed management, weed distribution, stability of weed populations, weed monitoring and control. Site-specific herbicide application. Agro-chemicals and fertilisers, patch spraying.

Unit 4: Use of microprocessor based systems and computer in precision agriculture, Automation.

Unit 5: Use of fuzzy logic, artificial neural network and genetic algorithm in precision agriculture and farm machinery and power system.

References

1. Zhang, Q. 2015. Precision Agriculture Technology for Crop Farming. CRC Press, New York.
2. Srinivasan, A. 2006. Handbook of Precision Agriculture – Principles and Applications. The Haworth Press, Inc., New York.
3. Brase, T.A. 2006. Precision Agriculture. Thomson Delmar Learning, New York.
4. Hermann, J.H. 2013. Precision in Crop Farming, Site Specific Concepts and Sensing Methods: Applications and Results. Springer, Netherlands.

MAE3 B03, Experimental and Whole Field Stress Analysis

Teaching Scheme

Lectures: 3 hours/week

Course Outcomes

At the end of this course, students will be able to

- Understand the concept of measurement of stress in machine components using various experimental techniques.
- Apply the principle of stress analysis for design and force analysis of tractor and farm machinery.

Syllabus Contents

Unit 1: Stress and strain relations. Basic equations and plane elasticity theory.
Unit 2: Theory of brittle coating method, crack detection, test and calibration procedure for brittle coating analysis
Unit 3: Strain measurement, electrical resistance strain gauges, semi-conductor strain gauges, strain gauge circuits, recording instruments, analysis of strain gauge data.
Unit 4: Optical methods of stress analysis, basic optics, Moire methods, theory of photo-elasticity, 2-D and 3-D photo-elasticity, birefringent coatings.
Unit 5: Application of stress analysis in the design and testing of tractor and farm machinery systems.

References

1. Ramesh, K. 2009. E-book on Experimental Stress Analysis. IIT Madras. http://apm.iitm.ac.in/smlab/kramesh/book_5.htm
2. Dally, J.W. and Riley, W.F. 1991. Experimental Stress Analysis, McGraw-Hill, New York.
3. Sharpe, W.N. 2008. Handbook of Experimental Solid Mechanics. Springer, Netherlands.
4. Pant, B., Gargesha, G., Lingaiah, K., Ramachandra, K., Srinath, L.S. and Raghavan, M.R. 1984. Experimental Stress Analysis. Tata McGraw Hill, New Delhi.

PROGRAMME ELECTIVES – III
MAE3 C01, Renewable Sources of Energy and Utilization

Teaching Scheme

Lectures: 3 hours/week

Course Outcomes

At the end of this course, students will be able to

- Understand the concept and utilization of various sources of renewable energy.
- Design various applications using the energy from renewable sources.
- Estimate the availability and utilization of energy from renewable sources

Syllabus Contents

Unit 1: Conventional and renewable energy sources in agriculture, solar radiation and its measurement, characteristics of spectrum, solar energy collection, storage and application, solar photo voltaic conversion and SPV powered systems.
Unit 2: Types of wind mills and their applications. Theory of drag and lift forces, Design of wind turbine.
Unit 3: Thermo chemical conversion of biomass, direct combustion of pyrolysis and gasification, chemical conversion processes, carbonization, briquetting, pelletization and densification.
Unit 4: Bio conversion into alcohols, methyl and ethyl esters, organic acids, solvents of amino acids, types of biogas plants, biogas properties, uses and distribution, alternate fuels for I.C. engines.
Unit 5: Energy requirement in agricultural production systems, energy ratio and specific energy value, inflow and outflow of energy in unit agricultural operation, energy audit, accounting and analysis.

References

1. Rao, S.S. and Parulekar, B.B.1999. Non-conventional, Renewable and Conventional. Khanna Publishers, New Delhi
2. Sukhatme, S.P.1997. Solar Energy - Principles of Thermal Collection and Storage.2nd

Edition, Tata McGraw Hill, New Delhi.
3. Grewal, N.S., Ahluwalia, S., Singh, S. and Singh, G. 1997. Hand Book of Biogas Technology. Solar Energy Fundamentals and Applications. Tata McGraw Hill, New Delhi.
4. Mittal, K.M. 1985. Biomass Systems: Principles & Applications. New Age International, New Delhi
5. Boyle, Godfrey. 1996. Renewable Energy: Power for Sustainable Future. Oxford University Press, London.

MAE3 C02, Energy Conservation and Management

Teaching Scheme

Lectures: 3 hours/week

Course Outcomes

At the end of the course, students will be able to

- Acquire insight about the importance of energy
- Analyze all scenarios from energy consumption
- Generate scenarios of energy consumption and predict the future trend
- Suggest and plan energy conservation solutions

Syllabus Contents

Unit 1: Energy resources on the farm: conventional and non-conventional forms of energy and their use. Heat equivalents and energy coefficients for different agricultural inputs and products. Pattern of energy consumption and their constraints in production of agriculture. Direct and indirect energy. The energy market, energy scenario, planning, utilization pattern and future strategy, Importance of energy management. Energy intensity, long term energy scenario, energy pricing, energy security, energy conservation and its importance, energy strategy for the future.

Unit 2: Energy auditing- methodology and analysis: Definition, energy audit, need, types of energy audit. Energy management (audit) approach-understanding energy costs, Bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution, energy audit instruments and metering. Energy audit of production agriculture, and rural living and scope of conservation.

Unit 3: Energy conservation planning and practices. Energy forecasting, Energy economics, Energy pricing and incentives for energy conservation, factors effecting energy economics. Energy modelling.

Unit 4: Energy Efficiency in Thermal Utilities and systems: Boilers, Steam system, Furnaces, Insulation and refractories, Heat exchangers, Waste heat recovery, Cogeneration, Heating, ventilation, air conditioning (HVAC) and refrigeration system. Identification of energy efficient machinery systems, energy losses and their management. Energy analysis techniques and methods: energy balance, output and input ratio, resource utilization, conservation of energy sources.

Unit 5: Energy and environment, air pollution, climate change: United Nations Framework Convention on Climate Change (UNFCC), sustainable development, Kyoto Protocol, Conference of Parties (COP), Clean Development Mechanism (CDM), CDM Procedures case of CDM – Bachat Lamp Yojna and industry; Prototype Carbon Fund (PCF).

References

1. Witte, L.C., Schmidt, P.S. and Brown, D.R. 1988. Industrial Energy Management and Utilization. Hemisphere Publishing Corp., New York.
2. O'Callaghan, P.W. 1981. Design and Management for Energy Conservation. Pergamon

Press, Oxford.
3. Reay, D.A. 1980. Industrial Energy Conservation, Pergamon Press, Oxford..
4. Nagrath, I.J. and Gopal, M. 1982. Systems : Modeling and Analysis. Tata McGraw Hill, New Delhi.
5. Doty, S. and Turner, W.C. 2012. Energy Management Handbook, 8th Edition. Fairmont Press, Libum, USA.
6. Dryden, I.G.C. 1982. The Efficient Use of Energy, 2nd Edition. Butterworth Heinemann, London.

MAE3 C03, Design of Solar and Wind Systems

Teaching Scheme

Lectures: 3 hours/week

Course Outcomes

At the end of the course, students will be able to

- Update about the technological status of implementation of NCES in India
- Analyze various techno-economical obstacles in the commercial development of NCES in India
- Conceptually model and design general NCES systems and predict the long term performance.
- Suggest and plan hybrid NCES solutions to conventional energy systems.

Syllabus Contents

Unit 1: Solar radiation analysis: Solar constant, Basic earth sun angles, Beam and diffused radiations, Radiation on titled surfaces (estimation), Measurement of solar radiation, Heat Transfer for Solar Energy Utilization: Basic models of heat transfer, Radiation characteristics of opaque materials and partially transparent media, Heat transfer analysis for flat plate collectors, Numerical problems

Unit 2:. Flat Plate Collectors: Physical principles of conversion of solar radiation into heat, Thermal Losses and efficiency of FPC, Practical considerations for flat plate collectors, Applications of FPC - Water heating and Drying. Focusing Type Collectors: Orientation and sun tracking systems, Types of concentrating collectors - Cylindrical parabolic collector, Compound parabolic collector, Thermal performance of focusing collectors, testing of solar collectors. Solar Green Houses, Solar thermo mechanical power, Solar refrigeration & air conditioning and Solar High Temperature Applications, Solar cooking, Solar desalination, Solar ponds and Solar space heating Solar Industrial process heating and Solar power generation. Fuel cells, thermionic, thermoelectric. Photovoltaic and Solar Thermal Systems.

Unit 3: Modern wind turbines, wind resources, wind Vs traditional electricity generation, technology advancements, material Usage. Applications: grid connected power, industrial applications, stand-alone system, water pumping, Wind resource assessment, Wind measurement

Unit 4: Aerodynamics: Aerofoil, two dimensional airfoil theory, relative wind velocity, Wind Turbines: Classification of wind turbines, Turbine components, Wind turbine design: Rotor torque and power, Power control, braking systems. Turbine blade design. Blade material, SERI blade sections,

Unit 5: Transmission and generation efficiency, Energy production and capacity factor, Torque at constant speeds, Drive train oscillations, Wind farm design

References

1. Goswami, D.Y., Kreith, F. and Kreider, J.F. 2000. Principle of Solar Engineering. Taylor

and Francis, London.
2. Sukhatme S.P. 1994. Solar Energy. Tata McGraw Hill Publishing Co. Ltd., New Delhi.
3. Rai, G.D. 2000. Non-conventional Energy Sources. Khanna Publishers, New Delhi.
4. Kreider, J.F. and Kreith, F. 1981. Solar Energy Handbook. McGraw Hill, New York.
5. Duffie, J.A. and Beckman, W.A. 2013. Solar Engineering of Thermal Processes. John Wiley & Sons, New Jersey.

PROGRAMME ELECTIVES – IV

MAE3 D01, Hydraulic System and Control

Teaching Scheme

Lectures: 3 hours/week

Course Outcomes

At the end of the course, students will be able to

- Understand hydraulic system and circuit of tractor, land reclamation machinery and other machines.
- Design and develop the hydraulic system and circuit for various applications.

Syllabus Contents

Unit 1: Principles of fluid power system. Hydraulic oil and fluid properties, filters and filtration. Hydraulic pumps-construction, sizing and selection.

Unit 2: Direction control valves, flow and pressure control. Hydraulic servo techniques-recent trends.

Unit 3: Linear actuators, rotary actuators and hydraulic transmission and steering. Heat generation and control, hydraulic reservoirs and accumulators. Electro hydraulic motors and hydrostatic transmissions, control components.

Unit 4: Design and application of hydraulic circuits, draft, position and mixed controls. Seals and packings, hydraulic pipes, hoses and fittings, hydraulic system maintenance, repair and reconditioning. Regenerative pump unloading, pressure intensifier circuits. Speed control of hydraulic motors, mechanical hydraulic servo systems for tractors.

Unit 5: Application of hydraulic power systems in farm power and machinery systems, off-road vehicles, land reclamation machinery etc.

References

1. Rabie, M.G. 2009. Fluid Power Engineering. McGraw Hill, New Delhi
2. Jagadeesha, T. and Gowda, T. 2009. Fluid Power: Generation, Transmission and Control. Wiley India Limited, New Delhi
3. Goering, C.E. and Hansen, A.C. 2013. Engine and Tractor Power. ASABE, USA.
4. Esposito, A. 2009. Fluid Power with Applications, 7th Edition. Pearson Education, New York.
5. Sullivan, J. 1997. Fluid Power: Theory and Applications, 4th Edition. Pearson Education, New York.

MAE3 D02, Fluid Power System and Automation

Teaching Scheme

Lectures: 3 hours/week

Course Outcomes

At the end of the course, students will be

- Aware of the importance and the scope of hydraulics and pneumatics in the modern industry.
- Able to select and size the different components required to design a fluid power system.
- Able to select a control system to control the operation of designed fluid power system.
- Able to design and implement low cost automation system.

Syllabus Contents

Unit 1: Hydraulic Power Generators - Selection and specification of pumps, pump characteristics. Linear and Rotary Actuators - selection, specification and characteristics.

Unit 2: Pressure - direction and flow control valves - relief valves, non return and safety valves - actuation systems. Reciprocation, quick return, sequencing, synchronizing circuits - accumulator circuits - industrial circuits – press circuits - hydraulic milling machine - grinding, planning, copying, forklift, earth mover circuits - design and selection of components - safety and emergency mandrels.

Unit 3: . Pneumatic fundamentals - control elements, position and pressure sensing, Pneumatic logic circuits - switching circuits - fringe conditions modules and these integration - sequential circuits - cascade methods - mapping methods – step counter method - compound circuit design - combination circuit design. Pneumatic circuits – properties of air. Compressors, control elements.

Unit 4: Pneumatic equipments - selection of components - design calculations -application - fault finding – hydro pneumatic circuits. Design of pneumatic circuits. Electrical control for fluid power circuits. Electronic sensors/ circuits used as controls in modern farm equipment. Maintenance of hydraulic and pneumatic circuits and devices. Trouble shooting

Unit 5: Use of microprocessors/microcontrollers for sequencing - PLC, Low cost automation - Robotic circuits.

References

1. Antony Esposito, 2014. Fluid power with Applications, 7th Edition. Prentice Hall India, New Delhi.
2. Pease, D.A. and Pippenger, J.J. 1987. Basic Fluid Power. Prentice Hall India, New Delhi
3. Parr, A. 1999. Hydraulic and Pneumatics. Jaico Publishing House, Mumbai.
4. Bolton. W. 1997. Pneumatic and Hydraulic Systems. Butterworth - Heinemann, London.
5. Majumdar, S.R. 1995. Pneumatic Systems: Principles and Maintenance Tata McGraw Hill, New Delhi.

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MAE3 D03, Land Reclamation Machinery

Teaching Scheme

Lectures: 3 hours/week

Course Outcomes

At the end of the course, students will be able to

- Understand the construction and working of various land reclamation machinery.
- Evaluate the performance of various land reclamation machinery.
- Select the appropriate machinery and apply the relevant machine management practices.

Syllabus Contents

Unit 1: Principles of mechanisms used in crawler tractors. Land reclamation and development, equipment for land reclamation.

Unit 2: Dozers, scrapers and excavators. Grading of sloppy lands, finishing equipment. Trucks

and hauling equipment. Compressed air, drilling rock and earth, blasting rock, aggregate production.

Unit 3:. Cranes, drag lines and clamshells, piles and pile driving equipment, equipment for pumping water, belt conveyor system

Unit 4: Automation of earth moving and grading machines. Production and equipment cost. Geotechnical materials, compaction and stabilization. Engineering fundamentals related to earth moving machinery: Swell, shrinkage and compaction measurements. Use of tractors & Crawlers and effects of altitude & temperature on their performance. Grade resistance and gradability.

Unit 5: Design considerations and performance evaluation of Earth moving machinery. Economic analysis of land development machinery. Application of PERT and CPM to the problems related to land development.

References

1. De, Amitosh. 2015. Latest Development of Heavy Earth Moving Machinery. Galgotia Publications Pvt. Ltd., New Delhi.
2. Herbert L. Nichols, Jr. 2005. Moving the Earth: The Workbook of Excavation, 5th Edition. McGraw-Hill, New York.
3. Borshchow, T., Mansurou, R. and Sergeev, V. 1988. Land Reclamation Machinery. MIR Publication, Moscow.
4. Alekseeva, T.V. 1985. Machines for Earthmoving Work: Theory and Calculations. Amerind Publishing Co., New York.

PROGRAMME ELECTIVES – V

MAE3 E01, Human Factors Engineering in the Design of Tractor and Farm Machinery

Teaching Scheme

Lectures: 3 hours/week

Course Outcomes

At the end of the course, students will be able to

- Understand the importance of anthropometry and strength parameters on the design of farm machinery.
- Design and develop farm machinery based on ergonomic considerations.
- Design the workspace considering safest and comfort of the operators.

Syllabus Contents

Unit 1: Definitions and development of ergonomics. Man-machine system. Anthropometry and workplace design principles. Tractor operator's working environment.

Unit 2:. Environmental stresses: thermal, dust and chemical stresses in agricultural operation. Physical and muscular fatigue in agricultural operation. Mental workload assessment. Work/rest schedule.

Unit 3:. Vibration and noise: evaluation, reduction, application in tractor, power tiller and self propelled machines.

Unit 4: Visual perception in tractor control panel design. Warning signs and warning labels, vision at the workplace. Principle and design of ROPS, International standards and testing of ROPS.

Unit 5: Application of Anthropometry and Ergonomics in the design of tractor and Farm Machinery Systems. Ergonomic evaluation of farm machinery.

References

1. Grandjean, E. and Kroemer, K.H.E. 1997. Fitting the Task to the Human: A Textbook of Occupational Ergonomics, 5th Edition. Taylor & Francis, Philadelphia.
2. Sanders, M. S. and McCormick, E. J. 1993. Human Factors in Engineering and Design. McGraw-Hill, New York.
3. Kroemer, K. H. E., Kroemer, H. B. and Kroemer-Elbert, K. E. 2000. Ergonomics: How to Design for Ease and Efficiency, 2nd Edition. Prentice-Hall, New York.
4. Stanton, N., Hedge, A., Brookhuis, K., Salas, E. and Hendrick, H. 2005. Handbook of Human Factors and Ergonomics Methods. CRC Press, Boca Raton.
5. Tayyari, F. and Smith, J. L. 1997. Occupational Ergonomics: Principles and Applications. Springer-Verlag, New York.

MAE3 E02, Finite and Boundary Element Methods in Engineering

Teaching Scheme

Lectures: 3 hours/week

Course Outcomes

At the end of the course, students will be able to

- Understand the application of FEM for stress analysis.
- Acquaint with the working of FEM and generate codes for specific applications.
- Apply FEM for the design and development of various machine components.

Syllabus Contents

Unit 1: Basic concepts: The standard discrete system, Finite elements of an elastic continuum-displacement approach.

Unit 2:. Generalization of the finite element concepts-weighted residual and variational approaches. Element types: triangular, rectangular, quadrilateral, sector, curved, isoparametric elements and numerical integration. Automatic mesh generation schemes.

Unit 3:. Application to structural mechanics problems: plane stress and plane strains, Axisymmetric stress analysis, three dimensional stress analysis, bending of plates.

Unit 4: Introduction to the use of FEM in steady state field problems-heat conduction, fluid flow and non-linear material problems, plasticity, creep etc.

Unit 5:. Computer procedures for Finite element analysis. Application of FEM for the design on tractor and farm machinery components.

References

1. Gupta, O.P. 1991. Finite and Boundary Element Methods in Engineering. CRC Press, New York.
2. Seshu, P. 2003. Textbook of Finite Element Analysis. PHI Learning Pvt. Ltd., New Delhi.
3. Cook, R.D. 2002. Concepts and Applications of Finite Element Analysis. Wiley, New Delhi.
4. Desai, C.S. 2005. Introduction to the Finite Element Method: A Numerical Method for Engineering Analysis. CBS Publishers, Bangalore.

MAE3 E03, Principles of Mechanization and Management

Teaching Scheme

Lectures: 3 hours/week

Course Outcomes

At the end of the course, students will be able to

- Select the appropriate machinery and power source for their effective utilization on the mechanized farm.
- Develop an optimum farm machinery management practices for the farm.
- Develop decision support system and apply the computer and internet for the management of farm resources and outputs.

Syllabus Contents

Unit 1: Introduction to mechanization, mechanization policy, components of a mechanization system, harvesting and spraying systems. Labour and machinery planning, timeliness and work day probability, Principles of human resource development and management, leadership development

Unit 2: Machine capacity, field machinery management, matching machines to create an efficient system. Machinery selection, soil/climate/implement interface. Machinery cost, valuation of machines. Identifying, monitoring and reducing machinery costs..

Unit 3:. Financing machinery, finance schemes and selection of appropriate scheme. Alternatives to ownership, contracting, hire schemes. Maintenance management. Machinery replacement, decision making, whole stock method and capital budget method. Principles of financial management.

Unit 4: Break-even analysis. Analysis and organization of various operation management programmes.

Unit 5:. Use of computer and internet in planning of tractor and farm machinery management, Development of decision support systems for tractor and farm machinery.

References

1. Hunt, D. 2001. Farm Power and Machinery Management, 10th Edition. Wiley, New York.
2. Hunt, D. 2001. Engineering Models for Agricultural Production . AVI Publishing Co., New York.

AUDIT COURSES

MASH 101, Research Methodology and IPR

Teaching Scheme

Lectures: 2 hours/week

Course Outcomes

At the end of this course, students will be able to

- Understand research problem formulation.
- Analyze research related information.
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Syllabus Contents

Unit 1: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

Unit 2: Effective literature studies approaches, analysis. Plagiarism, Research ethics.

Unit 3: Effective technical writing, how to write report, Paper. Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit 4: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit 6: New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References

1. Stuart Melville and Wayne Goddard, "Research methodology: An introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
5. Mayall, "Industrial Design", McGraw Hill, 1992.
6. Niebel, "Product Design", McGraw Hill, 1974.
7. Asimov, "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.

9. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008.

MASH 102, English for Research Paper Writing

Teaching Scheme

Lectures: 2 hours/week

Course Objectives

Students will be able to:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title
- Ensure the good quality of paper at very first-time submission

Syllabus Contents	**Hours**
Unit 1: Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	4
Unit 2: Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts.Introduction	4
Unit 3: Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	4
Unit 4: Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.	4
Unit 5: Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions	4
Unit 6: Useful phrases, how to ensure paper is as good as it could possibly be the first-time submission	4

Suggested Studies

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman’s book.
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

MASH 103, Disaster Management

Teaching Scheme

Lectures: 2 hours/week

Course Objectives

Students will be able to:

- Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Develop an understanding of standards of humanitarian response and practical relevance in

specific types of disasters and conflict situations.

- Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

Syllabus Contents **Hours**

Unit 1: Introduction Disaster: Definition, Factors and significance; Difference between hazard and disaster; Natural and manmade disasters: Difference, Nature, Types and magnitude. 4

Unit 2: Repercussions of Disasters and Hazards: Economic damage, Loss of human and animal life, Destruction of Ecosystem. 4
Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and famines, Landslides and avalanches, Man-made disaster: Nuclear reactor meltdown, Industrial accidents, Oil slicks and spills, Outbreaks of disease and epidemics, War and conflicts.

Unit 3: Disaster Prone Areas in India Study of seismic zones; Areas prone to floods and droughts, Landslides and avalanches; Areas prone to cyclonic and coastal hazards with special reference to tsunami; Post-disaster diseases and epidemics 4

Unit 4: Disaster Preparedness and Management Preparedness: Monitoring of phenomena triggering a disaster or hazard; Evaluation of risk: Application of remote sensing, Data from meteorological and other agencies, Media reports: Governmental and community preparedness. 4

Unit 5: Risk Assessment Disaster risk: Concept and elements, Disaster risk reduction, Global and national disaster risk situation. Techniques of risk assessment, Global Co-operation in risk assessment and warning, People's participation in risk assessment. 4
Strategies for survival.

Unit 6: Disaster Mitigation Meaning, Concept and strategies of disaster mitigation, Emerging trends in mitigation. Structural mitigation and non-structural mitigation, Programs of disaster mitigation in India. 4

Suggested Readings

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies", New Royal Book Company.
2. Sahni, Pardeep et al. (Eds.), "Disaster Mitigation Experiences And Reflections", Prentice Hall of India, New Delhi.
3. Goel S. L. "Disaster Administration And Management Text And Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi.

MASH 104, Sanskrit for Technical Knowledge

Teaching Scheme

Lectures: 2 hours/week

Course Objectives

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Syllabus Contents **Hours**

Unit 1: Alphabets in Sanskrit, 8
Past/Present/Future Tense,
Simple Sentences

Unit 2: Order 8
Introduction of roots
Technical information about Sanskrit Literature

Unit 3: Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics 8

Suggested Readings

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi

Course Outcomes

Students will be able to

- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science & technology can be understood
- Being a logical language will help to develop logic in students

MASH 105, Value Education

Teaching Scheme

Lectures: 2 hours/week

Course Objectives

Students will be able to

- Understand value of education and self- development
- Imbibe good values in students
- Let the should know about the importance of character

Syllabus Contents **Hours**

Unit 1: Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. 4

Moral and non- moral valuation. Standards and principles.
Value judgments

Unit 2: Importance of cultivation of values. 6

Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness.
Honesty, Humanity. Power of faith, National unity.
Patriotism. Love for nature, Discipline

Unit 3: Personality and Behavior Development - Soul and scientific attitude. Positive thinking. Integrity and discipline. 6

Punctuality, Love and kindness.
Avoid fault Thinking.
Free from anger, Dignity of labour.
Universal brotherhood and religious tolerance.
True friendship.
Happiness Vs suffering, love for truth.

Aware of self-destructive habits.
Association and Cooperation.
Doing best for saving nature

Unit 4: Character and Competence –Holy books Vs Blind faith. 6
Self-management and Good health.
Science of reincarnation.
Equality, Nonviolence, Humility, Role of Women.
All religions and same message.
Mind your Mind, Self-control.
Honesty, Studying effectively

Suggested Readings

Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

Course Outcomes

Students will be able to

- Knowledge of self-development
- Learn the importance of Human values
- Developing the overall personality

MASH 201, Constitution of India

Teaching Scheme

Lectures: 2 hours/week

Course Objectives

Students will be able to

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Syllabus Contents **Hours**

Unit 1: History of Making of the Indian Constitution: History, Drafting Committee (Composition & Working) 4

Unit 2: Philosophy of the Indian Constitution: Preamble, Salient Features 4

Unit 3: Contours of Constitutional Rights & Duties: 4

- Fundamental Rights
- Right to Equality
- Right to Freedom
- Right against Exploitation
- Right to Freedom of Religion
- Cultural and Educational Rights
- Right to Constitutional Remedies
- Directive Principles of State Policy
- Fundamental Duties.

Unit 4: Organs of Governance: 4

- Parliament
- Composition
- Qualifications and Disqualifications
- Powers and Functions
- Executive
- President
- Governor
- Council of Ministers
- Judiciary, Appointment and Transfer of Judges, Qualifications
- Powers and Functions

Unit 5: Local Administration: 4

- District's Administration head: Role and Importance,
- Municipalities: Introduction, Mayor and role of Elected Representative
- CEO of Municipal Corporation.
- Pachayati raj: Introduction, PRI: Zila Pachayat.
- Elected officials and their roles, CEO Zila Pachayat: Position and role.
- Block level: Organizational Hierarchy (Different departments),
- Village level: Role of Elected and Appointed officials.
- Importance of grass root democracy

Unit 6: Election Commission: 4

- Election Commission: Role and Functioning.
- Chief Election Commissioner and Election Commissioners.
- State Election Commission: Role and Functioning.
- Institute and Bodies for the welfare of SC/ST/OBC and women.

Suggested Readings

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes

Students will be able to

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

MASH 202, Pedagogy Studies

Teaching Scheme

Lectures: 2 hours/week

Course Objectives

Students will be able to

- Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Syllabus Contents **Hours**

Unit 1: Introduction and Methodology: 4

- Aims and rationale, Policy background, Conceptual framework and terminology
- Theories of learning, Curriculum, Teacher education.
- Conceptual framework, Research questions**.**
- Overview of methodology and Searching.

Unit 2: Thematic overview: 2

- Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.
- Curriculum, Teacher education.

Unit 3: Evidence on the effectiveness of pedagogical practices 4

- Methodology for the in depth stage: quality assessment of included studies.
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?
- Theory of change.
- Strength and nature of the body of evidence for effective pedagogical practices.
- Pedagogic theory and pedagogical approaches.
- Teachers' attitudes and beliefs and Pedagogic strategies.

Unit 4: Professional development: alignment with classroom practices and follow up support 4

- Peer support
- Support from the head teacher and the community.
- Curriculum and assessment
- Barriers to learning: limited resources and large class sizes

Unit 5: Research gaps and future directions 2

- Research design
- Contexts
- Pedagogy
- Teacher education
- Curriculum and assessment
- Dissemination and research impact.

Suggested Readings

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.

5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes

Students will be able to understand:

- What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

MASH 203, Stress Management By Yoga

Teaching Scheme

Lectures: 2 hours/week

Course Objectives

- To achieve overall health of body and mind
- To overcome stress

Syllabus Contents	**Hours**
Unit 1: Definitions of Eight parts of yog. (Ashtanga)	8
Unit 2: Yam and Niyam.	8

- Do`s and Don't's in life.
- Ahinsa, satya, astheya, bramhacharya and aparigraha
- Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

Unit 3: Asan and Pranayam 8

- Various yog poses and their benefits for mind & body
- Regularization of breathing techniques and its effects-Types of pranayam

Suggested Readings

1. "Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course Outcomes

Students will be able to

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

MASH 204, Personality Development Through Life Enlightenment Skills

Teaching Scheme

Lectures: 2 hours/week

Course Objectives

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

Syllabus Contents	**Hours**
Unit 1: Neetisatakam-Holistic development of personality	8

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

Unit 2: Approach to day to day work and duties. 8

- Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

Unit 3: Statements of basic knowledge. 8

- Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37, 38, 63

Suggested Readings

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. "Bhartrihari's Three Satakam (Niti-sringar-vairagya)" by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes

Students will be able to

- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students.

OPEN ELECTIVES

MASH A01, Business Analytics

Teaching Scheme

Lectures: 3 hours/week, Total Number of Lectures: 48

Course Objectives

- Understand the role of business analytics within an organization.
- Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
- To become familiar with processes needed to develop, report, and analyze business data.
- Use decision-making tools/Operations research techniques.
- Manage business process using analytical and management tools.
- Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

Syllabus Contents	**No. of lectures**
Unit 1: Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.	9
Unit 2: Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.	8
Unit 3: Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.	9
Unit 4: Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.	10
Unit 5: Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.	8
Unit 6: Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.	4

Course Outcomes

- Students will demonstrate knowledge of data analytics.
- Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
- Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
- Students will demonstrate the ability to translate data into clear, actionable insights.

References

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, Pearson Education.

MASH A02, Industrial Safety

Teaching Scheme

Lectures: 3 hours/week

Syllabus Contents

Unit-I: Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Unit-II: Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-III: Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit-IV: Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit-V: Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

References

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, McGraw Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

MASH A03, Operations Research

Teaching Scheme

Lectures: 3 hours/week

Course Outcomes

At the end of this course, students will be able to

- Apply the dynamic programming to solve problems of discreet and continuous variables.
- Apply the concept of non-linear programming.
- Carry out sensitivity analysis.
- Model the real world problem and simulate it.

Syllabus Contents

Unit 1: Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit 2: Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Unit 3: Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit 4: Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit 5: Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation.

References

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub., 2009
5. Pannerselvam, Operations Research: Prentice Hall of India, 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India, 2010

MASH A04, Cost Management of Engineering Projects

Teaching Scheme

Lectures: 3 hours/week

Syllabus Contents

Introduction and Overview of the Strategic Cost Management Process

Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting

3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A.H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

MASH A05, Composite Materials

Teaching Scheme

Lectures: 3 hours/week

Syllabus Contents

Unit 1: Introduction: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

Unit 2: Reinforcements: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

Unit 3: Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

Unit 4: Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

Unit 5: Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Text Books

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

MASH A06, Waste to Energy

Teaching Scheme

Lectures: 3 hours/week

Syllabus Contents

Unit 1: Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.

Unit 2: Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods – Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit 3: Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit 4: Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.- Design and constructional features - Biomass resources and their classification - Biomass

Unit 5: Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion – Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

References

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.