Syllabus of B.Tech. (Mech. Engg.) Courses having focus on employability / entrepreneurship / skill development

MECHATRONICS

Paper Code	**BM–305**
Course Credits	**4**
No. of Lectures/week	3
No. of Tutorials/week	1

Course Description

Unit-I

Introduction to Mechatronics: Origin& evolution of Mecha tronics. Objectives, Advantages, And Disadvantages of Mechatronics, System Interfacing, Instrumentation and Control Systems, open and cloosed Loop Systems, Sequential Systems.

Elements of Mechatronics: Sensors and Transducers, Timers. Ssignal Conditioning, Signal Nomenclature, Signal Processing. Digital Logic. Microprocessor-based Digital Control, Basic Elements of control systems, Microprocessor Architecture, Terminology, instruction Types, Addressing Models, Intel 8085A Microprocessor, Microcontrollers, Relayand Programmable Logic Controller.

Unit - II

Pneumatics & Electro Pneumatics: Introduction to Pneumatics.Air Compression, Distribution andTreatment. Directional Control valves. Electro Pneumatic Components. Circuit Design. Pneumatic Actuation System,Practical Exercises

Unit-III

Actuators and Mechanisms: Actuator Types and application Areas, Electromechanical Actuators, DC Motors, AC Motors, Fluid Power Actuators, Piezoelectric Actuators, Magnetostrictive Actuators, Memory-metal Actuator, Ion-Exchange Polymer-metal Composites, Chemical Actuator, Mechanisms, Bearings, Belt, Chain, Pulleys, Gears, Rack and Pinion, Ratchet, Pawl and Crank, Slider and Crank, Cams and Follower, Chain and Sprocket, Geneva Wheel, Four-bar Linkages.

Unit-IV

Modelling: Systems, Modelling, Mechanical System, Electrical Systems, Fluid Systems, Thermal Systems, Engineering System, Translational Mechanical System with spring, Damper and Mass. Rotational Mechanical Systems with Spring, Damper and Mass, Modelling Electric Motor, Modelling Chamber Filled with Fluid, Modelling Pneumatic Actuator.

Unit-V

Intelligent Systems and Their Applications- Advance Actuators, Consumer Mechatronics Products, Hydraulic Fingers, Surgical Equipment, Industrial Robot, Autonomous Guided Vehicle (AGV),Drilling Machine, Conveyor-based Material Handling Systems.

	Mechatronics in Manufacturing Production Unit, Input/output and Challenges in Mechatronics Production Units, Knowledge Required For Mechatronics in Manufacturing, Main Features of Mechatronics in Manufacturing, Computer Integrated Manufacturing, just- in-Time Production Systems, Mechatronics and Allied Systems.
Pre-Requisite Courses (/ Papers):	Theory of Machines, Manufacturing Process, Basic Electrical & Electronics Engineering, Instrumentation and Control.
Textbooks:	• W. Bolton, 'Mechatronics', Pearson Education New Delhi... • N P Mahalik Mechatronics Principle, concept & Application, Tata McGraw-Hill, New Delhi
Reference books:	• Robert H. Bishop, 'Mechatronics Hand Book', CRC Press, New York • J.R Groot, 'Introduction to Pneumatics', Fluid Power Education Foundation, Milwaukee.
Course Objective	The Objective of this course is to impart the skills and knowledge that are not confined to a single subject area, but a range of engineering disciplines. Students completing a course will be capable of working in a number of interesting areas i.e. process engineering, product design, manufacturing, automation, quality and business process, green engineering and research and development.
Course Outcomes	CO1: Introduction to Mechatronics and understanding its origin, evolution and future aspects. CO2: Plan for sustainable and effective solutions through the application of mathematics, science and engineering fundamentals to study Pneumatics. CO3: Advancing the knowledge of different types of actuators and deriving various related mechanisms. CO4: Present technical and scientific findings effectively by using sophisticated modelling techniques. CO5: Introduction to modern machinery and intelligent systems used in industries.
Computer Usage / Software required:	MATLAB, EP-I.

INSTRUMENTATION, MEASUREMENT AND CONTROL

Paper Code	**BM – 405**
Course Credits	**4**
No. of Lectures/week	3
No. of Tutorials/week	1

Course Description

Unit- I

General Concepts: Measurement, Instrumentation, significance, standards, Methods, Methods and Modes of Measurement.

Instruments-Classification and functional elements of a Measurement System. Static performance characteristics-Errors and Uncertainties, Propagation of Uncertainties, Performance Parameters, Impedance. Loading and Matching. Graphical representation and curve fitting of Data-Equations of Approximating curves. Determination of Parameters in linear relationship. Method of Least square and linear least square curve fitting. Related Numerical problems.

Unit -II

Dynamic characteristics of Instruments-Dynamic Inputs, Formulation of system equations, Dynamic Response. Transducer Elements. Intermediate Elements- Amplifiers, A-D and D-A converters, filters, Terminology and conversions, Data Transmission Elements, Related Numerical Problems

Unit -III

Measurements, Methods and Applications- Force Measurement, Torque and Power Measurements, Presume Measurement (High Pressure Moderate and vacuum) Related Numerical Problems.

Unit-IV

Temperature Measurement: - Non-electrical, electrical and Radiation Methods of Temperature Measurement. Flow measurement-Primary, Secondary and special Methods of flow Measurement, Measurement of liquid Level, Biometrics and Air pollution parameters. Related Numerical Problems.

Unit- V

Control Engineering–Classification, Applications of control Engineering, Feedback control system with their block diagrams, Transfer functions of elements, systems and processes. Transient and Steady State Response of control systems, stability of control systems. Related Numerical Problems.

Pre-Requisite Courses (/ Papers): Basic courses of Physics, Electronics and Electrical Engineering

Text books:

- Measurement Systems by Ernest O. Doebelim, Tata McGraw Hill Publication.
- Instrumentation, Measurement and Analysis by Nakra and Choudhary, Tata McGraw Hill Publication.

Reference books:

- Mechanical Measurement by Beckwith and Buck, Oxford and IBH.
- Instrumentation for Engineering Measurement by Dally, William

	and Mc Connell, John Wiley and Sons.
Course Objective	• To provide knowledge of Measurable quantities, their detection, acquisition, control and analysis of measurement data this is important phenomena in almost all areas of Science Engineering and Technology. • To be aware with instrument characteristics, the measurement principles, methods, constructional feature, advantages and limitations of the instruments. • To study control engineering, small and compact type control systems, their working principles and applications.
Course Outcomes	CO1: Recognise the instrument systems, their principles, methods of measuring different physical variables and analysis of data. CO2: Formulation of system equations and extending the knowledge of dynamic inputs and response. CO3: Solve problems related to measurement of Force, Torque, Power and Pressure. CO4: Acquire knowledge of recent developments in instrumentation and measurement of Temperature. CO5: Recognise the control engineering, their types, different systems and processes, their applications in Industries and House hold appliances
Computer Usage / Software required:	ANSYS, Excel, MATLAB and similar software, Lab view
Other details regarding this course	This course is of predominant importance for machine control integrating mechanical systems and futuristic development.

ELECTROMECHANICAL ENERGY CONVERSION

Paper Code	**BTM-505**
Course Credits	**4**
No. of Lectures/week	3
No. of Tutorials/week	1
Course Description	**Unit - I** Three Phase Induction Motor: Construction, Principle of operation, torque-slip characteristics, relation between slip and speed, losses, speed control. **Unit - II** Synchronous Generator: Principle of operation, emf equation, voltage regulation by synchronous impedance method, efficiency. Synchronous Motor: Principle of operation, effect of excitation, V-curves. **Unit - III** Single phase induction motor, Stepper motor, Switch reluctance motor, PMMC motor their characteristic and control. Standard voltages used in generation, transmission. Generating station, sub-station: equipment and layout. **Unit - IV** Switchgear, relays, timers: their types, Introduction to PLC, ADC (Analog to digital converter), DAC (Digital to Analog converter). **Unit - V** Power Electronics and application: Characteristics of SCR, Turn ON-Off methods, rectifier, inverter, chopper, AC voltage controller, speed control of ac and dc motor.
Pre-Requisite Courses (/ Papers):	Elements of Electrical and Electronics Engineering.
Text books:	• Robert Boylested, Louis Nashelky, "Electronic Devices and Circuit Theory" Sixth Edition, Prentice Hall of India Pvt. Ltd. New Delhi, India.
Reference books:	• Electric Machinery Fundamentals, Stephen J. Chapman, McGraw Hill Book Co. • Digital Circuits and Logic Design, Morris Manno, Prentice Hall of India Pvt. Ltd., New Delhi. • Electrical Machines, NagrathI.J. and D.P. Kothari, Tata McGraw Hill, New Delhi. • Introduction to Power Electronics Rashid, M. H, Prentice Hall, India, New Delhi.
Course Objective	To transfer the basic knowledge of electrical engineering to the students of Mechanical engineering, and also for allied Mechanical Engineering. Jobs
Course Outcomes	CO1: Understanding the concepts principles and operation of three phase induction motor CO2: Learning the working, principle and characteristics of synchronous motor and generator

	CO3: Expanding the knowledge of various types of motors and their characteristics CO4: Principle and design of switchgear and their types. CO5: Basics of power electronic and its application
Computer Usage / Software required:	MATLAB, etc.

REFRIGERATION AND AIR-CONDITIONING

Paper Code	**BM-604**
Course Credits	**4**
No. of Lectures/week	3
No. of tutorials/week	1
Course Description	

Unit-I

Refrigerating Machine: The second law interpretation, Heat engine and Heat pump and refrigerating machine. Reversed Carnot cycle for vapour, vapour compression cycle. Actual vapor compression cycle. Effect of Super Heating, the suction vapour, super-heating with useful cooling and super-heating, which produces useful cooling. Effect of pressure losses, Liquid-Suction heat exchanger, removal Flash gas, Intercooling, Compound Compression with water inter-cooling, Compound Compression with liquid flash cooler.

Multi-pressure Systems: Multistage of compound compression, choice of intermediate pressure, complete multistage Compression system. Multi-evaporator system single compressor individual expansion valves, single compressor-multiple expansion valves, individual compressor-multiple expansion valves, individual compressors with compound compression. Cascade systems.

Unit-II

Refrigerants: classification of refrigerants, Designation of refrigerants, Selection of refrigerant, required properties of an ideal refrigerant, Secondary refrigerants, Brine.

Condenser: Air cooled condensers, water cooled condensers, heat transfer in condensers, Fouling Factor, water side co-efficient, superheating, Finned tubes air cooled and evaporative condenser.

Spray Ponds and cooling towers, and water treatment plant.

Expansion Devices: Automatic or constant pressure expansion valve, thermostatic Expansion valves. Capillary tube and its sizing.

Unit-III

Refrigeration Equipment: Evaporators: flooded evaporators, liquid chiller, direct expansion coil, Heat transfer during boiling. Fluid side heat transfer, Overall performance.

Absorption Refrigeration System: Simple vapour absorption system, Co-efficient of Performance of absorption systems. Lithium -Bromide-Absorption refrigeration system, Brief Study of Domestic Refrigerators, Solar Refrigeration, Reversed Brayton cycle.

Compressors: Types of compressor, Reciprocating, rotary and centrifugal (Brief description) Volumetric efficiency of reciprocating compressor and H.P. required. Factors affecting the performance of reciprocating compressor, Capacity control of compressor.

Unit-IV

Air-conditioning: Psychrometry, Definition of Psychometric properties, Psychrometric relations, Psychrometric chart, Psychrometric processes,

	Thermodynamicwetbulbtemperature, Calculation of air properties, Summer air-conditioning system for hot and dry outdoor conditions and for hot and humid air conditions, winter air-conditioning system, Year round air-conditioning system. **Unit-V** Requirement of comfort air Air-conditioning: Effective temperature economic consideration for selecting the comfort point, Cooling load calculation; sum load, Load from occupants, equipment load, Infiltration air load, fan load, fresh air Load. Design of air-conditioning systems, Cooling load and air quantities, Central air-conditioning system, and unitary air-conditioning system, Comfort indices, Control, Duct design
Pre-Requisite Courses (/ Papers):	Thermodynamics, Heat Transfer, & Fluid Mechanics.
Text books:	Refrigeration and Air-conditioning by C.P. Arora, McGraw-Hill.
Reference books:	• Fundamental of Refrigeration by Dossat – McGraw Hill • Refrigeration and Air-conditioning by P.L. Ballaney, Khanna. Publication
Course Objective	• Clear all concepts of Refrigeration Cycles • Clear all concepts of Heating, Ventilation and Air-conditioning systems and cycles • Introduce to Green, Intelligent Buildings • Train students to work as an HVAC Engineer.
Course Outcomes	CO1: Introduction of Refrigerating machines and multi-pressure systems. CO2: Understanding the classification and selection of refrigerants and condensers. CO3: Learning various refrigeration equipment's. CO4: Introduction to basic concepts of air-conditioning. CO5: Understanding the requirement of comfort air-conditioning
Computer Usage / Software required:	• Students can be introduced to basic simulation software such as Fluent; HEVACOMP, Primavera, and other CFD modelling techniques.
Other details regarding this course (if any)	• HVAC is a big industry & student has prospects of becoming Design Engineer; Site Engineer; Procurement Engineer; Project Engineer etc.;

ENERGY SOURCES

Paper Code	**BM-704**
Course Credits	**4**
No. of Lectures/week	**3**
No. of tutorials/week	1
Course Description	**Unit-I** Introduction: Sources of conventional and renewable energy, Trends of energy consumption, Fossil fuel availability and limitations, Need to develop new energy sources. Energy Economy. **Unit-II** Solar Energy: Solar radiation, characteristics and estimation, Solar Collectors, Flat Plate and concentrating types; Their comparative study, design; Heating of air and water for building and other uses, Thermal storages, Solar Ponds, Solar pumps, Solar Power, Solar Cookers etc. Direct Conversion of Solar energy to electricity. **Unit-III** Biomass Systems: Biomass conversion – Combustion, gasification, aerobic digestion, pyrolysis, digesters and their design; Performance analysis & testing – Thermal applications & power generation. **Unit-IV** Wind Energy: Wind turbines and their characteristics; Types of rotors, horizontal axis and vertical axis systems, system design, site selection and Performance analysis. Tidal Energy: Sites, potentiality and possibility of harnessing from site, limitations. **Unit-V** Geo-thermal Energy: Sites, potentiality and limitation, study of different conversion systems. Ocean Energy: Principle of utilization and its limitations, description of various systems. Energy from waste and other sources.
Pre-Requisite Courses	Fluid Mechanics I&II, Applied Thermodynamics, A.T.H.T
Text books:	• G.N. Tiwari & S. Suneja: Solar Thermal Energy Systems, Narosa Publishing House
Reference books:	• S.P. Sukhatme: Solar Energy – Principles of Thermal Collection & Storage, Tata McGraw Hill. • H.P. Garg: Advances in Solar Energy Technology, D. Reid Publishing House • A.N. Mathur and N.S. Rathore: Biogas Production, Management and Utilization, Himansu Publications. • K.C. Khandelwal& S.S. Mandi: Practical Hand Book of Biogas Technology

Course Outcomes	CO1: Introduction to unconventional manufacturing process and its classification. CO2: Understanding the principles and working of various unconventional machining processes. CO3: Brief study of applications of unconventional machining processes. CO4: Unconventional Welding processes: Explosive welding, Cladding, under water welding, Metalizing, Plasma arc welding Laser Beam welding, Friction Stir welding. CO5: Principle, working and applications of high energy forming processes such as explosive forming, Electromagnetic forming, Electro-Discharge forming, Water hammer forming, Explosive compaction.

AUTOMOBILE ENGINEERING

Paper Code	**BM-803**
Course Credits	**4**
No. of Lectures/week	3
No. of Tutorials/week	1

Course Description

Unit-I

Components of Automobile and their compositions, chassis, Power unit,general layout of automotive vehicle, Engine performance characteristics, Turbo charging and supercharging, Multi cylinder engines and their arrangements, Firing order

Unit-II

Rolling, air or wind and gradient resistance, Power requirement, Matching of engine power with demand power, Tractive effort, Vehicle performance, Gear Box, Drive effectiveness, Relationship for two and four-wheel vehicles.

Unit-III

Power transmission, Clutch and its types, Gear boxes—Sliding mesh, constant mesh, synchromesh and epicyclic arrangements, Propeller shaft, universal joint, Differential and its analysis, live axle, floating and full floating axle system.

Unit-IV

Steering system, steering geometry—camber, castor, king pin rake, combined angle toe in, Types of steering mechanisms: Ackerman steering mechanism, Davis steering mechanism, steering linkages, power steering.
Tyres and its types, specifications and construction, tyres ground contact area, material and disposal of tyres.

Unit-V

Suspension system and its need, types of suspension system—Rigid axle suspension system, torsion bar, Independent suspension system, shock absorbers.
Braking system, mechanical braking system, disc and drum brakes, hydraulic brakes, master cylinder, wheel cylinder, tandem cylinder, brake fluid and its properties, weight transfer during braking and stopping distances.

Pre-Requisite Courses (/ Papers): Thermodynamics, Fluid Mechanics, Heat and Mass Transfer

Text books:

- The motor vehicle by K. Newton, W. Steeds and T. K. Garret, ESBS Publications

Reference books:

- Automobile Engineering by G. B. S. Narang
- Automotive Mechanics—Principles and practices by Heitner Joseph , East-West Press
- Automobile Engineering, Kirpal Singh, Standard Publishers
- Automotive Chassis, by P.L. Kohli, Papyrus publications
- Auto mechanics, by Michell, McGraw Hill Publications.

Course Objective	• Automobile Engineering by S K Gupta, S Chand publisher • Automobile Engineering by D S Kumar, S K Kataria and Sons. • Automotive Technology, Heinz and Hizler, ELBS Edition • To develop an understanding of basics of an automobile function. • To make students competent enough to be absorbed in automobile industries.
Course Outcomes:	CO1: Introduction to components of automobile and their composition. CO2:Learning the concepts of rolling with various resistance gradients and developing relationship between two and four-wheel vehicles. CO3: Understanding the concepts of power transmission. CO4: Learning the concepts of steering system. CO5: To learn about suspension systems; braking systems.
Computer Usage / Software required:	Relevant Industry software
Other details regarding this course	This course is of predominant importance in automobile engineering and its Indian perspective for Mechanical Engineering.

Syllabus of M.Tech. (Mech. Engg.) Courses having focus on employability / entrepreneurship / skill development

ADVANCED MATHEMATICS

MEC-101 L-3 T-1 P-0

No. of contact hours/semester: 50

Course Objective: This course is structured in order to provide insight knowledge about the application of mathematics in engineering practices.

UNIT-I Applications of Laplace transforms and I.L.T. in the particular solution of integral equations and integro-differential equations, Z-transforms and its applications in the solution of linear difference equations, Use of DeMoiver's theorem, Ferrari/Descarte method, Cardan's method, reciprocal-equation method in the general solution of higher order ordinary linear differential equations with constant and variable coefficients, Use of Euler-Poisson equations in Calculus of Variations (i.e. external of functional), Isoperimetric problems.

UNIT-II Infinite Fourier transforms, infinite Fourier sine and cosine transforms and its applications, Fourier-Legendre series, Fourier-Bessel series, Product solutions of Laplace equations, heat conduction equations, wave equations, Poisson's equations by the method of separation of variables and its applications in boundary value problems, General solution of homogeneous and non-homogeneous linear partial differential equations of higher order with constant and variable coefficients.

UNIT-III Envelope of a family of curves, Evolute of a curve, Geometrical representation of W = f (z), Conformal mapping, Problems on Tensor analysis, Properties of eigen values of square matrices of order 4, 5 and 6, and complex matrices, Numerical solution of boundary value problems using finite difference and cubic spline methods, Numerical solution of heat conduction equations, Poisson, Laplace and wave equations.

UNIT-IV Interpolation, Aitken and Aitken-Neville methods, Missing-terms problems, Hermite Interpolation, Fitting of a curve in given sub-interval using cubic spline interpolation, Representation of a tabulated function in powers of (x –a) using Newton's

divided difference formula, Applications of numerical successive differentiation in practical problems and double interpolation.

UNIT-V Numerical integration using Romberg method, Gauss-Legendre and Lobatto methods, Gaussian integration and numerical double integration; Conversion of a differential equation into integral equation and vice versa, Solutioins of Fredholm and Volterra integral equations of first and second kinds; Numerical solution of a system of non- linear equations using Newton-Raphson method; Solution of system of linear equations in four variables using Gauss-Jorden and Crout's methods.

RECOMMENDED / REFERENCE BOOK:

1. *"Advanced Engineering Mathematics",* by Erwin Kreyszig, Wiley Eastern India Ltd.
2. *"Higher Engineering Mathematics",* by B.S. Grewal, Khanna Publishers.
3. *"Introductory Methods of Numerical Analysis*", S.S. Sastry, 3rd edition, Prentice Hall of India (PHI)
4. *"Numerical Methods for Scientific and Engineering Computation",* by M.K.Jain, S.R.K. lyengar and R.K. Jain, 4th edition, New Age International Pvt.Ltd.
5. *"Advanced Engineering Mathematics*", by M.K.Jain, S.R.K.lyengar and R.K.Jain, 4th ediation, New age International Pvt.Ltd.

TECHNICAL COMMUNICATION

MEC-203 L-3 T-1 P-0

No. of contact hours/semester: 28

Course Objective: Writing has been always considered to be most difficult of all forms of communication. As is said by Gerald Brenan "**It is by sitting down to write every morning that one becomes a writer**". It requires talent and hard work both "**Genius begins beautiful works, but only labor finishes them**" Joseph Joubert. This subject deals with technical writing, considered to be very valuable skill today. It adds a new dimension to the career, irrespective of working in any capacity. And today it is itself a rewarding career. We will have class discussions on the textbook which is very through and well researched on the subject. You will be required to write one formal report as well.

UNIT I Scope of Technical Writing

- What Is Technical Writing? - Attributes of Technical Writing, Other Types of Writing
- Reasons for Writing - Excuses for Not Writing, Benefits of Technical Writing
- Performing Technical Studies - Types of Technical Studies, General Methodology

UNIT II Strategy, Options and Criteria for Technical Writing

- Writing Strategy - Analysis of Readers, Scope of Writing, Purpose and Objective, Writing to Various Readers
- Document Options - Document Hierarchy, Report Types and Selection
- Criteria for Good Technical Writing - Technical Content, Presentation, Language Skills

UNIT III Style and Illustrations of Technical Writing

- Writing Style - Elements of Style, Examples of Writing Styles, Recommended Style
- Using Illustrations - Reasons for Using Illustrations, How to Prepare Effective Illustrations, Captions for Illustrations, Referring to Illustrations

UNIT IV Formal and Informal Reports

- Formal Reports: The Outline and Introduction – Outline, Title, Front Matter, Writing the Introduction, Putting It Together
- Formal Reports: Writing the Body - Writing a Procedure, Describing Machines/Processes, Writing Test Results, Writing the Discussion Section
- Formal Reports: Closure – Conclusions, Recommendations, References, Writing an Abstract, Back Matter, Report Distribution, Saving Reports
- Informal Reports - Elements of an Informal Report, Investigation Reports, Service Work, Action Letters, Proposals

UNIT V Review, Presentation and Effectiveness Measurement

- Review and Editing - Types of Review and Edit, Reviews, Edits, Review and Editing Methodology, Examples of Reviews
- Oral Presentations - Types of Oral Presentations, Preparation, Visual Aids, Presentation
- Getting It Done - Impediments to Writing, Maintaining Writing Skills, Measuring Report Results

Add Unit VI : Types of Reports and Their requirements Summer Training report

M Tech Project Report Technical Paper for a journal/conference

Textbook

Kenneth G. Budinski, Engineer's Guide to Technical Writing, ASM International, 2001**,**
ISBN: 978-0-87170-693-5

STATISTICS FOR DECISION MAKING
MEC-202 L-3 T-1 P-0

No. of contact hours/semester: 50

Course Objective: This course has been designed to provide the basic knowledge of statistics and its subsequent application to engineering problems to arrive at meaningful decision.

Software required: MINITAB, SPSS

UNIT -I : Deciphering the functions: Collecting data- Reducing large volumes of data by sampling, Comparing your collection against the population; Extracting information from data Determining central tendency using various methods e.g.- Mean, Median, Mode, Mid- range, Calculating spread of data, Range, Variance, Standard Deviation and Ensuring confidence and accuracy. Designing graphs: Summarizing data visually, applying the appropriate graph type to simplify presentation.

UNIT-II: Distribution of the data: Sampling and Sampling Distributions, Inference: Interval Estimation, Hypothesis Testing about the Mean & Proportion of Single Populations. Modeling data with bell curves, Dividing data into percentiles, Identifying outliers, Hypothesis Testing about the Mean & Proportion of Two Populations, Chi-Square Tests of Goodness-of-fit & Independence, Simple Regression and Correlation and Analysis, Multiple Regression Analysis and Correlations Analysis Applying analysis of variance (AN OVA) to decision making.

UNIT-III : Assessing Risks,Assigning probability: Probability: Concepts, Theorems, & Rules, Discrete Probability Distribution - (Binomial only), Continuous Probability Distributions (Uniform & Normal), Determining the odds of success or failure, Building

a frequency matrix to illustrate possibilities, Identifying scenarios that affect outcomes, Calculating probability based on a chain of events, Minimizing risks: Interpreting the level of risks within your project, justifying decisions based on calculation of probability

UNIT-IV Theory of game. 2 (two) person zero sum game, minimax and maxmin strategies, solution of games by dominance rules, Basic techniques for solving stochastic linear and non-linear programming problems.

UNIT-V Resolving problems with statistical solutions. Computer based statistical analysis. Project on case preparation.

RECOMMENDED / REFERENCE BOOK:

1. *Statistics for Business and Economics, by James 1. McClave, P. George Benson, and Terry Sincich, Tenth Edition, Prentice Hall. 2008. A student solutions manual is packaged with the text.*
2. *David ivi. LevinefTimothy C Krehbiel/Mark L. Berenson. "Business Statistics". 2nd Ed.Person Education Asia.*
3. *Richard, L Levin and David S. Ruben, (2003), "Statistics for Management" Hal! of India Pvt. Ltd., New Delhi*
4. *Hoel, Paul Gl "Statistics as applied to Business and Economics/' Wiley, New York*

Land Fill Gas: From Environment to Energy

MET-109 L-3 T-1 P-0

Unit 1 Landfill Gas to Energy: Status and Prospects

Introduction, Importance of landfill gas, overview of landfill gas industry, Phases of LFG Generation, Factors affecting LFG Generation, Energy Potential of LFG, Benefits of LFG to Energy Recovery projects.

Unit 2 Planning and conceptual design of LFG Recovery System

Criteria for identifying suitability of landfill sites for LFG recovery, LFG recovery from open dumps, controlled landfills, and sanitary landfills, Horizontal and vertical LFG Collection Systems.

Unit 3 Landfill Gas Flaring

Passive Venting of LFG, Types of Flaring System, Description of LFG Flaring System, Open flaring system versus Enclosed flaring system, case Studies on LFG Flaring Systems.

Unit 4 Landfill Gas Modeling

Introduction, Conceptualization of LFG Model, Benefits of Landfill Gas Modeling, Sizing LFG collection, and utilization systems, Projections of LFG emissions.

Unit 5 Economic Feasibility of LFG to Energy Projects

Economic feasibility of LFG to Energy project, Evaluation of Costs and Benefits, case studies.

1) From Landfill Gas to Energy: Technologies and Challenges

Vasudevan Rajaram (Autor), Faisal Zia Siddiqui (Autor), M. Emran Khan (Autor)

Hardcover: 325 pages

Publisher: CRC Press; 1 edition (December 15, 2011)

2) Landfill Gas: From Environment to Energy [Hardcover]

A Gendebien (Author), M. Pauwels (Author), M. Constant (Author), M.-J Ledrut-Damanet (Author)

Hardcover: 880 pages

Publisher: European Commission (31 Dec 1992)

3) Landfill Methane Recovery ("Energy Technology Review" S.) [Hardcover] M.M. Schumacher

(Editor) Hardcover:

558 pages

Publisher: Noyes Data Corpn.,U.S. (1 Aug 1983)

4) Methane Generation and Recovery from Landfills Emcon Associates, Consolidated Concrete Limited Hardcover: 150 pages
Publisher: CRC Press; 1 edition (July 15, 1980)

MODERN MANUFACTURING METHODS

MEP-102 L-3 T-1 P-0

No. of contact hours/semester: 50

Course Objective: Modern Manufacturing method course is designed to acquaint students the latest technological developments in area of manufacturing processes

Software required:

UNIT-I

Need for new technology materials and processes. Classification of new technology. Historical Background of New Technological Processes. Definitions and Applications of Advances in Machining: Machining Speed Considerations, Advanced Cutting Tool Materials, High Speed Machining, Ultra Precision Machining, Hard Turning.

UNIT-II

Super-Finishing Processes: Need, classification, process principle and applications of Abrasive Flow Finishing, Magnetic Abrasive Flow Finishing, Magnetic Abrasive Finishing, Electrogel Magnetic Abrasive Finishing, Magneto-
Rheological Finishing.

UNIT-III

Advances in Forming: Explosive/Magnetic-pulse/Peen forming processes, Manufacturing of Honeycomb Structure, Electro hydraulic forming, Electro magnetic forming, Laser Bending, Powder rolling, Spray rolling, Hydro forming, Hydrostatic and Powder extrusion, rotary and isothermal forming.

UNIT-IV

Advances in Foundry: - Investment Casting, Single Crystal Casting, Continuous Casting and Rolling Mills, Squeeze Casting and Semi-solid Metals Forming, Shaping of Ceramics.

UNIT-V

Surface Coating and Joining Processes, Flux Cored Arc Welding, Under Water Welding, and Welding of Ceramics.

Surface Coating: Coating of Ceramics- Brief introduction to Vapor Deposition, Sol-Gel, Metallization, Thermal Spraying etc. Chemical Vapor Deposition and Physical Vapor Deposition. Rapid Prototyping: Introduction to regenerative manufacturing process like SLS, LOM. Fused Deposition Manufacturing

RECOMMENDED / REFERENCE BOOK:

1. M V Grower- Modern Manufacturing Process, John Wiley
2. Adithan M. 'Modern Machining Methods" S. Chand & Company Ltd.
3. Bhattacharya Amitabha, "New Technology", Institution of Engineers (India).
4. Pandey P.C. and Shan H.S. " Modern Machining Processes" Tara- McGraw Hill, New Deihi
5. V.K.jair1, .Advance Machining Processes, .A.lIied Pubiisher
6. Ghosh and Malik, Manufacturing Science, E\NP Private Ltd.
7. ASM Handbook-VoL 1 0

WELDING TECHNOLOGY
MEP-106 **L-3 T-1 P-0**

No. of contact hours/semester: 50

Course Objective: The objective of this course is to impart knowledge to the students about latest welding technology that is being used by industries.

Software required:

Unit-I

Welding Metallurgy: Welding as compared with other fabrication processes, Classification of welding processes; Heat affected zone and its characteristics; Effects of alloying elements on weldability, Weldability of steels, stainless steel, cast iron, and aluminum and titanium alloys, Weld testing standards, Hydrogen embrittlement, Metallurgical aspects of joining, Conditions of soldering, Brazing and welding of materials.

Unit-II

Weld Design & Quality Control: Principles of sound weld design, Welding joint design, Welding defects; Testing of weldment, Material joining characteristics, Welding positions, Weld throat thickness; Weld quality, Discontinuities in welds, their causes and remedies and quality conflicts.

Unit-III

Modern Trends in Welding: Friction stir welding, Explosive welding, Diffusion bonding, Ultrasonic welding, Electron beam welding, Plasma arc welding, Laser welding.

Unit-IV

Mechanisation in Welding: Mechanisation of flat/circular joints, Thin/thick sheets (resistance/arc weld), Mechanisation of I beams (arc weld), Longitudinal circumferential SA welding (roller blocks, column booms, flux supports), Circular/spherical welding joints (rotating tables positioners), Manufacture of welding longitudinal welded pipes by induction, TIG, Plasma and SA welding of spiral welded pipes.

Unit –V

Robotics in Welding: Robot design and applications in welding, Programming of welding robots, tolerances for assemblies for robot welding, New generation of welding robots, Self alignment by current arc variation, Robots for car body welding, Microelectronic welding and soldering, Efficiency of robotics in welding.

Text Book:

1. Welding Technology and Design, VM Radhakrishnan, New Age International

2. Advanced Welding Processes, Nikodaco & Shansky, MIR Publications
3. Source Book of Innovative welding Processes, M.M. Schwariz Americal Society of Metals (Ohio)
4. Manufacturing Technology (Foundry, Forming and Welding), P.N. Rao, Tata McGraw Hill

FOUNDRY TECHNOLOGY

MEP-103 **L-3** **T-1** **P-0**

No. of contact hours/semester: 50

Corse Objective: To impart knowledge to the students on various aspects of metal foundry practices and various operations involved in it. Apart from metal melting, mould design and special metal casting processes the course also aims to disseminate knowledge on health, safety and environment related issues associated with the foundry operations.

Software required: Appropriate Multimedia, Simulation and Animations system e.g. Calcosoft, Mavisflow and FEMAP etc.

Unit -I

Selection of Metals and alloys for Casting. Melting Furnaces (Crucible Electric Arc Induction cupola et) and Melting of Metals. Melting Fluxes, Role and Functions of Fluxes. Solidification of Castings, Solidification time of Castings.

Heat Treatment of Casting: Principles of various heat treating processes, the effect of processing on the properties of metals and the dependence of metal properties upon alloying **Unit -II**

Casting Design considerations: Design and Design Considerations for Mould, Gating System, Riser. Spiral Mould Method for Checking Fluidity. Gating Ratio. Aspiration Effect. Filling Time Estimation.

Casting Defects: Their causes and their removal. Cleaning of Casting,

Unit -III

Inspection, repairs and salvage of Casting: Detection of defects, cracks, and inclusions within solids by means of radiation, elastic strain energy, electromagnetism, optics, etc. Quality Control in Foundries

Unit -IV

Special Casting Processes: Sand Mould Casting, Shell Mould Casting, Investment Casting, Die Casting, Single Crystal Component Casting.

Specific Foundry Considerations for Grey CI, Steel and non-ferrous Foundry Practices. Foundry Mechanization.

Unit -V

Pollution Control in Foundries: Possible Sources of Pollution in Foundries, e. g.: Water Treatment Units, Workshops and Garage, Storage Facilities, Air Emissions fro various furnaces and casting processes

Text Books:

M.P. Groover "Principles of Foundry Technology", Wiley India Pvt Ltd, New Delhi, 2009.

Reference Books:

Amitabh Gosh, Asok Kumar Mallick, "Manufacturing Science", East West Publication. Rao P.N., "Manufacturing Technology", Tata McGraw Hill, 2003.

Ramana Rao T.V., "Metal Casting Principles & Practices", New Age INT, New Delhi, 2003.

Heine & Rosenthal, "Principle of Metal Casting", Tata McGraw Hills, New Delhi, 2003.

A.K. Chakrabarti, Casting Technology and Cast Alloys. PHI Learning

A.K. Chakrabarti, steel Making, PHI Learning

Lindberg R.A., "Processes & Materials of Manufacture", Prentice Hall Publication, 1998.