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JAMIA MILLIA ISLAMIA
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Department of Mechanical Engineering
Faculty of Engineering and Technology

12th May, 2016

Minutes of the Meeting of BOS held on 12th May, 2016

A meeting of the members of Board of Studies of the Department of Mechanical Engineering, Faculty of Engineering and Technology, Jamia Millia Islamia, New Delhi was held on 12th May, 2016 at 3:00 P.M in the office of the Head. Following members were present.

1.	Prof. J.A.Usmani	Chairman and Head of the Department
2.	Prof. S. M. Yahya	Co-opted Member
3.	Prof. Khalid Moin	Nominated Member
4.	Prof. Mohd. Islam	Member
5.	Prof. M. Emran Khan	Member
6.	Prof. M. M. Hasan	Member
7.	Prof. Z. A. Khan	Member
8.	Prof. Z. Mallick	Member
9.	Prof. Mohd Suhaib	Member
10.	Prof. M. N. Karimi	Member
11.	Prof. Abdur Rahim	Member
12.	Prof. Aas Mohd.	Member
13.	Prof. Arshad Noor Siddiquee	Member
14.	Dr. S.M. Muzakkir	Member
15.	Dr. Islam Nawaz	Member
16.	Dr. Sabah Khan	Member
17.	Dr. Ali Hasan	Member
18.	Dr. Mohd Asjad	Member
19.	Dr. A. F. Sherwani	Member
20.	Mr. Mohd. Javaid	Member
21.	Mr. Mohd. Shoeb	Member

Following members were granted leave of absence

1.	Prof. S. G. Deshmukh	Co-opted Member
2.	Prof. Saranjeet Singh	Nominated Member
3.	Prof. Abid Haleem	Member
4.	Mrs. Halima Begum.	Member
5.	Mr. Lokesh Kumar	Member

The meeting started at 3:00 p.m. The chairman welcomed all the members present in the meeting.

Following items were discussed and approved in the meeting.

1. Minutes of the BOS meeting held on 21st April, 2016, were confirmed.

2. Teaching load of faculty members of the department for Odd and Even Semesters for the session 2016-17 for B.Tech. and M.Tech.(Mech.) courses was approved after incorporating suggestions/changes discussed in the meeting. The members authorized the Head of the Department to make changes as per the requirements (Annexure-I).

3. Under any other items, following were discussed and approved:

   i. The revised and updated CBCS course structure was discussed and approved. (Annexure-II)

   ii. The letter of the Dean, Faculty of Engineering and Technology, seeking discussion on the lateral entry Diploma Engineering holders was discussed. The members discussed the matter at length and disapproved the lateral entry of Diploma Engineering holders into the B.Tech. regular Program.

   iii. The members authorized the Head of the Department to appoint paper setters, moderators and paper evaluators for the Ph.D. entrance examination for the session 2016-17.

   iv. The name of B.Tech. (I) semester course Basic Mechanical Engineering has been changed to Elements of Mechanical Engineering and the syllabus of the same has been redesigned which will be communicated to the Head Applied Science Department for further necessary action.

4. The meeting ended at 4: 15 pm with a vote of thanks to the chair.

(Professor J.A.Usmani)
Chairman, BOS

HEAD
MECH. ENGG. DEPTT.
JAMIA MILLIA ISLAMIA
NEW DELHI-110025

Copy to:

1. All the members of the BoS of Mechanical Engineering Department.
2. The Dean, Faculty of Engineering and Technology, JMI.
3. The Registrar, JMI for information and necessary action.
4. P. S. to Vice Chancellor for the kind information of Vice Chancellor, JM.I
5. BOS file.

Note: *Any clarifications and comments on the minutes may kindly be brought to the notice of the chairman, BOS. If no comments are received within a week of the issue, the minutes will be deemed as confirmed.*

Syllabus of the Value added Courses

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, Nagrath I.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.

	• 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
Course Objective	• 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.

NUMERIC AND SCIENTIFIC COMPUTING

Paper Code	**BM - 406**
Course Credits	**4**
No. of Lectures/week	3
No. of Tutorial/week	1

Course Description

Unit –I

Interpolation withEqual and Unequal Intervals of the Arguments:
Newton-Gregory, Gauss, Stirling and Bessel Formulae, Aitken & cubic spline interpolation methods for equal intervals; Newton's divided difference and Lagrange's formulae for unequal intervals; Inverse interpolation using Lagrange's formula, method of successive approximations and double, triple interpolation.

Unit -II

NumericalDifferentiation and Numerical Integration**:**
Numerical successive differentiation using forward, backward, central differences interpolation formulae, Lagrange's and Newton's divided difference interpolation formula. Numerical integration using Simpson's 3/8 rule, Boole's rule, Weddle's rule, Romberg integration, Gauss-Legendre, Lobatto, Radau and Guass–Chebyshev rules. Errors in Quadrature formulae and numerical double integration.

Unit- III

NumericalSolutions ofAlgebraic andTranscendental Equations:
Bisection, Regula- False position, Newton-Raphson, Graeffe's root-squaring methods for the solution of non-linear algebraic & transcendental equations involving one variable, rate of convergence and error analysis of the methods, Newton-Raphson method for the solution of a system of non-linear equations of two and three variables.

Unit- IV

Numerical Solution of a System of Simultaneous Linear Equations and Curve Fitting**:**
Gauss elimination & Gauss-Jordan methods, Ill conditioned linear system, Gauss-Seidel and Crout methods for the solution of a system of linear equations in four unknowns; General curve (linear, quadratic, exponential and other non-linear functions) fitting using method of least squares.

Unit -V

Numerical Solutions of Initial and Boundary Value Problems:
Numerical approximate solutions of a system of simultaneous and higher order ordinary differential equations using Taylor's series method, Picard's method and Runge-Kutta fourth order method; Runge-Kutta- Fehlberg method, Euler's modified and Milne's methods; Numerical solution of boundary value problems using finite difference method, shooting method and cubic spline method.

Pre-Requisite Engineering Mathematics-I, II & IIT Objective Mathematics and handling

Courses (/ Papers):	the Scientific Calculator
Text books:	• Numerical methods for Scientific and Engineering Computation, M.K. Jain, S.R.K. Iyengar& R. K. Jain, New Age International (P) Ltd. • Introductory Methods of Numerical Analysis, Sastry, S S, Prentice Hall of India Pvt. Ltd.
Reference books:	• Numerical Methods for Engineers Steven C. Chapra& Raymond P. Canale,Tata McGraw Hill Book Co. • Computer Oriented Numerical Methods, Rajaraman; V, Prentice Hall of India Pvt. Ltd. • Elements of numerical analysis, Radhey S. Gupta, Macmillan India Ltd.
Course Objective	To understand basic Mathematics for solving Engineering Problems
Course Outcomes	Students will be able to understand computer orientated numerical methods as given below: CO1- Interpolation with Equal and Unequal Intervals of the Arguments CO2- Numerical Differentiation and Numerical Integration CO3- Numerical Solutions of Algebraic and Transcendental Equations CO4- Numerical Solution of a System of Simultaneous Linear Equations and Curve Fitting CO5- Numerical Solutions of Initial and Boundary Value Problems
Computer Usage / Software required:	MATLAB, EXCEL, MAXIMA, MATHEMATICA etc.
Other details regarding this course	Problem solving will enable students to solve Mechanical Engineering Problems.

INTERNAL COMBUSTION ENGINES

Paper Code	**BM - 605**
Course Credits	**4**
No. of Lectures/ week	3
No. of Tutorials/week	1
Course Description	**Unit-I** I.C. Engines: Introduction and Engine classification; Major Applications; S.I. and C.I. Engines operation; Working principles merits and demerits of 2-Stroke and 4 stroke engines; Concept of Combustion processes; Scavenging of Two Stroke Engines. Supercharging & Turbo charging. **Unit-II** S.I. Engines: Introduction- Stages of Combustion in S.I Engines, Thermodynamics analysis of Fuel-Air cycle, Abnormal Combustion, Fuel metering, carbureter and Fuel injection systems. **Unit-III** C.I. Engines: Introduction- Stages of Combustion in C. I. Engines, Significance of Delay Period. Premixed and Diffusion Combustion processes. Knocking phenomena, Types of Combustion Chambers. Fuel metering & fuel injection systems. **Unit-IV** Gas Turbine & Jet Propulsion: Thermodynamics analysis of Actual Gas Turbine Cycle. Gas Turbine Combustors. Turbojet, Turboprop, Turbofan, Ramjet and Scramjet Engines. Rocket Engines. **Unit-V** Fuels: Fuels used in S.I., C.I. Engines & Gas Turbines, Non-conventional Fuels, its Fuel characteristics and their rating. Alternative Fuels. Emission from S.I & C I Engines & its Control.
Pre-Requisite Courses (/ Papers):	Applied Thermodynamics, Fluid Mechanics and Heat and Mass Transfer
Text books:	• Internal Combustion Engine by V. Ganesan; Tata McGraw Hill Publication
Reference books:	• Internal Combustion Engines Fundamentals by John B. Heywood; McGraw Hill • Internal Combustion Engines and Air Pollution, by Edward F. Obert Harper & Row Publishers • Internal Combustion Engine by Sharma &Mathur; DhanpatRai& Sons
Course Objective	• To impart knowledge and understanding of basic concept and working of different types of Engines. • To make the student capable enough to be employed by Engine Manufacturers.

Course Outcomes	CO1: Expanding the knowledge of different type of engines with working principles, merits and demerits CO2: Learning the stages of combustion for S.I engine and its thermodynamic analysis CO3: Detailed analysis of stages of combustion for C.I engine and fuel injection system CO4: Thermodynamic analysis of gas turbine and jet propulsion. CO5: Understanding the behaviour of fuel in various engines and turbines.
Computer Usage / Software required:	Dynomation-5; Engine simulation and other related software

INDUSTRIAL ENGINEERING

Paper Code	**BM-705**
Paper Credits	**4**
No. of Lectures/week	3
No. of Tutorials/week	1
Course Description	**Unit-I** Systems approach, Definition and scope of Industrial Engineering. Historical developments... Production and production systems. Productivity. Value Engineering: Introduction to value engineering. Phases and application Site location and factors affecting site location. Assembly line balancing. Learning curve. **Unit-II** Motion and Time Study: Process Analysis: Process chart, activity charts, man and machine charts and operation process charts. Motion study: Motion analysis, camera study, micro motion study, cyclograph and Chronocyclograph. Fundamental hand motions. Principles of motion economy and human body, arrangement of workplace in respect of tools and equipment Time Study: Information recording, data recording by continuous, repetitive and cumulative timing, determining number of observations, the rating factor, performance rating, allowances determination, normal and standard time. Synthetic time and introduction to predetermined times. Work sampling: theory, procedures, and applications. **Unit-III** Inventory: Inventory concepts, inventory costs. Inventory models assuming certainty and quantity discounts. Inventory management. ABC analysis. Material Requirement Planning (MRP). Introduction to Enterprise Resource Planning. Just in Time, Supply Chain Management and critical chain. Material Handling. **Unit-IV** Quality: Definition, dimension and related concepts. Economics of quality. Acceptance sampling by attributes, Operating characteristic curve, producing and consuming risks, single, double and sequential sampling plans. Acceptance sampling by variables. Average outgoing quality. **Unit-V** Quality Management: Control charts for variables. Control chart for attributes. Seven Quality control tools Quality Circle. Quality Systems, Total Quality Management.
Pre-Requisite Courses (/ Papers):	Operation Research, Engineering Economy and Management.
Text books:	• Motion and Time Study Design and Measurement of Work", Ralph M. Barnes, John Wiley & Sons. New York. • Introduction to Statistical Quality Control, Douglas C.

	Montgomery, John Wiley & Sons. New York
Reference books:	• Martinich, Joseph S, "Production and Operations Management: An Applied Modern Approach," John Wiley, Re. Ed
Course Objective	Industrial Engineering has evolved and established itself as a branch of engineering. A basic overview of different areas covered in this branch of engineering is provided.
Course Outcomes	CO1: Recognise the basic concepts related to productivity, quality, inventory, site location, learning curves, assembly line and other emerging areas of Industrial Engineering. CO2: Solve problems involving productivity inventory, quality control, sampling and making of control charts, quality circle, time study, motion study and value analysis and site location. CO3: Inventory: Inventory concepts, inventory costs. Inventory models assuming certainty and quantity discounts. Inventory management. ABC analysis. Material Requirement Planning (MRP). Introduction to Enterprise Resource Planning. Just in Time, Supply Chain Management and critical chain. Material Handling. CO4: Quality: Definition, dimension and related concepts. Economics of quality. Acceptance sampling by attributes, Operating characteristic curve, producing and consuming risks, single, double and sequential sampling plans. Acceptance sampling by variables. Average outgoing quality. CO5: Understanding the concept of quality management, Control charts for both variable and attributes, Concept of TQM
Computer Usage / Software required:	• E.g. EXCEL and other Industrial Engineering Software.
Other details regarding this course	This course is of predominantly important in industry and needs lots of industrial visits and awareness of what best practices are being followed.

ERGONOMICS

Paper Code	**BM-804**
Course Credits	**4**
No. of Lectures/week	3
No. of Tutorials/week	**1**
Course Description	**Unit-1** Introduction to ergonomics, scope of ergonomics, cost of ignoring ergonomics, result of application of ergonomics, Ergonomics and its areas of application in the work-system, Description of Human-Machine system. Standard format for describing human-machine system. **Unit-II** Muscular Work: Physiological Principles, Sources of Energy, Nervous control of movements and structure of nervous system: Types of nervous system, Neurons, Action potential, Sodium potassium pump, innervations of muscles, Reflex-arc. Dynamics and static muscular work. Field method for assessing physical overload. **Unit-III** Design aspect in ergonomics: Manufacturing work-station design; Determining work-station design parameters, Systematic approach for determining work-station design, determining work-station dimension. Tool evaluation and design: Principles of tool design (General principles, Anatomical concern, and Single handle); Attributes of common industrial hand tools, Attributes of common industrial power tools, Tool evaluation check list. Displays and controls. **Unit-IV** Cumulative Trauma Disorder: Work-related Musculoskeletal Disorder: Definition of work-related Musculoskeletal Disorder, Types of WMSDs, Factors affecting WMSDs. Occupational Human Vibration: Characteristics of vibration, Whole-body and hand-arm vibration, Effect of vibration on comfort, health and performance. **Unit-V** Sound and related studies: Definition, evaluation of noise, combining decibels. Levels and Spectra: Sound power level, sound intensity level, numerical problems on sound its measurement
Pre-Requisite Courses (/ Papers):	Industrial Engineering
Text books:	• Introduction to Ergonomics-R.S. Bridger, McGraw-Hill International Edition.

Reference books:	• Industrial Noise Control-Lewis H-Bell and Douglas H-Bell, Marcel Dekker, INC. • Fitting Tasks to Human, Kroemer, K.H.E. and Grandjean, E. (1997). Philadelphia: Taylor and Francis • The Ergonomic Edge-MacLeod, D. (1995). New-York: Van NostrandReinhold.
Course Objective	• Provide students with the basis of occupational ergonomics. • Ergonomic considerations in design, ergonomic consideration in re-design and research basis of ergonomics.
Course Outcomes	CO1: Understand the fundamental of ergonomics (Human Factors) principles of design and evaluation. CO2: Be able to describe an expanded view of ergonomics, which encompasses more than ergonomically related injuries but all parts of assuring that the work-place fits the worker. CO3: Be able to put ergonomic assessments and solutions to practical use in the work place. CO4: Will be capable of initiating evaluations of ergonomic issues and working with an ergonomist. CO5: Understanding the concept of Sound and related studies, Numerical problems on sound its measurement
Computer Usage / Software required:	Adobe Acrobat Reader, Power Point or PP viewer, Video Player.

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:

2. *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.*

3. *David ivi. LevinefTimothy C Krehbiel/Mark L. Berenson. "Business Statistics". 2nd Ed.Person Education Asia.*
4. *Richard, L Levin and David S. Ruben, (2003), "Statistics for Management" Hal! of India Pvt. Ltd., New Delhi*
5. *Hoel, Paul Gl "Statistics as applied to Business and Economics/' Wiley, New York*

M. Tech. Mechanical Engineering First-Semester

Advanced Engineering Mathematics Code No. ASC-901

Common Syllabus for Production and Industrial Engineering, Machine Design and Thermal Engineering.

Mid-Semester examination: 40 Marks 4 Credits

End-Semester examination: 60 Marks{4 Lectures per week}

UNIT- I

Reciprocal equations of degree 4, 5 and 6, Ferrari method for bi-quadratic equations.

Summation of a series by the method of finite differences.

Least squares polynomial approximation of a continuous function over given interval and weight function.

UNIT- II

Change of independent variables in ordinary differential equation and partial differential equation.

Product solution of one-dimensional heat equation (diffusion equation)by the method of separation of variables and related boundary value problems.

Formation of ordinary linear differential equations of higher order with constant coefficients, whose general solution is given.

UNIT- III

Conversion of integral equation into ordinary differential equation.

Square roots and cube roots of a square matrix and related problems.

Numerical solutions of non-linear equations in two and three variables using Newton-Raphson method.

UNIT- IV

Application of Binomial theorem and De-Moivre's theorem in evaluation of some typical integrals based on Laplace transforms and other transforms.

Radius of curvature, point of inflexion, maxima and minima, missing terms, numerical differentiation and numerical integration in a given tabulated function and related problems.

Centre of curvature and evolute of a curve, Involute.

UNIT- V

Lobatto four-point formula, Radau three-point formula, Gauss-Hermite three-point formula for a definite integral and their applications in double, triple integrals, mass and moment of inertia. Simple Laguerre polynomials, Chebyshev's polynomials of second kind, Fourier-Laguerre series, Fourier Chebyshev series and related problems.

Numerical values of first five non-zero terms of ordinary Bessel function, modified Bessel function and other special functions.

Books recommended

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 by S.S. Sastry, Prentice Hall of India (PHI).
4. Numerical Methods for Scientific and Engineering Computation by M.K. Jain, S.R.K. Iyengar and R.K. Jain, New Age International Publishers.

NUMERIC AND SCIENTIFIC COMPUTING

Paper Code	**BM – 406**
Course Credits	**4**
Lectures / week	3
Tutorial / week	1
Course Description	**Unit –I** Interpolation with Equal and Unequal Intervals of the Arguments: Newton-Gregory, Gauss, Stirling and Bessel Formulae, Aitken & cubic spline interpolation methods for equal intervals; Newton's divided difference and Lagrange's formulae for unequal intervals; Inverse interpolation using Lagrange's formula, method of successive approximations and double, triple interpolation. **Unit -II** Numerical Differentiation and Numerical Integration**:** Numerical successive differentiation using forward, backward, central differences interpolation formulae, Lagrange's and Newton's divided difference interpolation formula. Numerical integration using Simpson's 3/8 rule, Boole's rule, Weddle's rule, Romberg integration, Gauss-Legendre, Lobatto, Radau and Guass–Chebyshev rules. Errors in Quadrature formulae and numerical double integration. **Unit- III** Numerical Solutions of Algebraic and Transcendental Equations: Bisection, Regula- False position, Newton-Raphson, Graeffe's root-squaring methods for the solution of non-linear algebraic & transcendental equations involving one variable, rate of convergence and error analysis of the methods, Newton-Raphson method for the solution of a system of non-linear equations of two and three variables. **Unit- IV** Numerical Solution of a System of Simultaneous Linear Equations and Curve Fitting**:** Gauss elimination & Gauss-Jordan methods, Ill conditioned linear system, Gauss-Seidel and Crout methods for the solution of a system of linear equations in four unknowns; General curve (linear, quadratic, exponential and other non-linear functions) fitting using method of least squares. **Unit -V** Numerical Solutions of Initial and Boundary Value Problems: Numerical approximate solutions of a system of simultaneous and higher order ordinary differential equations using Taylor's series method, Picard's method and Runge-Kutta fourth order method; Runge-Kutta- Fehlberg method, Euler's modified and Milne's methods; Numerical solution of boundary value problems using finite difference method, shooting method and cubic spline method.
Pre-Requisite Courses (/ Papers):	Engineering Mathematics-I, II & IIT Objective Mathematics and handling the Scientific Calculator
Text books:	• Numerical methods for Scientific and Engineering Computation, M.K. Jain, S.R.K. Iyengar& R. K. Jain, New Age International (P) Ltd. • Introductory Methods of Numerical Analysis, Sastry, S S, Prentice Hall of India Pvt. Ltd.

Reference books:	• Numerical Methods for Engineers Steven C. Chapra& Raymond P. Canale,Tata McGraw Hill Book Co. • Computer Oriented Numerical Methods, Rajaraman; V, Prentice Hall of India Pvt. Ltd. • Elements of numerical analysis, Radhey S. Gupta, Macmillan India Ltd.
Course Objective	• To understand basic Mathematics for solving Engineering Problems
Course Learning Outcomes	• Student will be able to solve and model Engineering problems.
Computer Usage / Software required:	MATLAB, EXCEL, MAXIMA, MATHEMATICA etc.
Other details regarding this course	Problem solving will enable students to solve Mechanical Engineering Problems.

INTERNAL COMBUSTION ENGINES

Paper Code	***BM - 605***
Course Credits	***4***
Lectures / week	*3*
Tutorials / week	*1*
Course Description	***Unit-I***

I.C. Engines: Introduction and Engine classification; Major Applications; S.I. and C.I. Engines operation; Working principles merits and demerits of 2-Stroke and 4 stroke engines; Concept of Combustion processes; Scavenging of Two Stroke Engines. Supercharging & Turbo charging.

Unit-II

S.I. Engines: Introduction- Stages of Combustion in S.I Engines, Thermodynamics analysis of Fuel-Air cycle. Real Cycle, Abnormal Combustion, Fuel metering and Fuel injection systems.

Unit-III

C.I. Engines: Introduction- Stages of Combustion in C. I. Engines, Significance of Delay Period. Premixed and Diffusion Combustion processes. Knocking phenomena, Types of Combustion Chambers. Fuel metering & fuel injection systems.

Unit-IV

Gas Turbine & Jet Propulsion: Thermodynamics analysis of Actual Gas Turbine Cycle. Gas Turbine Combustors. Turbojet,

Turboprop, Turbofan, Ramjet and Scramjet Engines. Rocket Engines.

Unit-V

Fuels: Fuels used in S.I., C.I. Engines & Gas Turbines, Non-conventional Fuels, Fuel characteristics and their rating. Alternative Fuels. Emission from S.I & C I Engines & Control.

Pre-Requisite Courses (/ Papers):

- *Applied Thermodynamics, Fluid Mechanics and Heat and Mass Transfer*

Text books:	• *Internal Combustion Engine by V. Ganesan; Tata Mc Graw Hill Publication*
Reference books:	• *Internal Combustion Engines Fundamentals by John B. Heywood;* • *Internal Combustion Engines and Air Pollution, by Edward F. Obert Harper & Row Publishers* • *Internal Combustion Engine by Sharma & Mathur; Dhanpat Rai & Sons*
Course Objective	• *To impart knowledge and understanding of basic concept and working of different types of Engines.* • *To make the student capable enough to be employed by Engine Manufacturers.*
Course Learning Outcomes	• *To differentiate between different types of Engines.* • *To learn the normal and abnormal combustion phenomenon of S I & C I Engines.* • *To know the requisite characteristics of Fuels.* • *To learn the various methods of Supercharging & Turbo charging.* • *To understand the emission and their control techniques.*
Computer Usage / Software required:	*Dynomation-5; Engine simulation and other related software*

INDUSTRIAL ENGINEERING

Paper Code	**BM-705**
Paper Credits	**4**
Lectures / week	4
Tutorials / week	--
Course Description	

Unit-I

Systems approach, Definition and scope of Industrial Engineering. Historical developments... Production and production systems. Productivity. Value Engineering: Introduction to value engineering. Phases and application Site location and factors affecting site location. Assembly line balancing. Learning curve.

Unit-II

Motion and Time Study: Process Analysis: Process chart, activity charts, man and machine charts and operation process charts.

Motion study: Motion analysis, camera study, micro motion study, cyclograph and chronocyclograph. Fundamental hand motions. Principles of motion economy and human body, arrangement of workplace in respect of tools and equipment

Time Study: Information recording, data recording by continuous, repetitive and cumulative timing, determining number of observations, the rating factor, performance rating, allowances determination, normal and standard time.

Synthetic time and introduction to predetermined times. Work sampling: theory, procedures, and applications.

Unit-III

Inventory: Inventory concepts, inventory costs. Inventory models assuming certainty and quantity discounts. Inventory management. ABC analysis. Material Requirement Planning (MRP).
Introduction to Enterprise Resource Planning. Just in Time, Supply Chain Management and critical chain. Material Handling.

Unit-IV

Quality: Definition, dimension and related concepts. Economics of quality. Acceptance sampling by attributes, Operating characteristic curve, producing and consuming risks, single, double and sequential sampling plans. Acceptance sampling by variables. Average outgoing quality.

	Unit-V Quality Management: Control charts for variables. Control chart for attributes. Seven Quality control tools Quality Circle. Quality Systems, Total Quality Management.
Pre-Requisite Courses (/ Papers):	Operation Research, Engineering Economy and Management.
Text books:	• Motion and Time Study Design and Measurement of Work", Ralph M. Barnes, John Wiley & Sons. New York. • Introduction to Statistical Quality Control, Douglas C. Montgomery, John Wiley & Sons. New York
Reference books:	• Martinich, Joseph S, "Production and Operations Management: An Applied Modern Approach," John Wiley, Re. Ed
Course Objective	Industrial Engineering has evolved and established itself as a branch of engineering. A basic overview of different areas covered in this branch of engineering is provided.
Course Learning Outcomes	Knowledge and understanding On successfully completing this paper, students will be able to: • Recognise the basic concepts related to productivity, quality, inventory, site location, learning curves, assembly line and other emerging areas of Industrial Engineering. Skills and other attributes On successfully completing this course unit, students will be able to: Intellectual skills • Solve problems involving productivity inventory, quality control, sampling and making of control charts, quality circle, time study, motion study and value analysis and site location.
Computer Usage / Software required:	• E.g. EXCEL and other Industrial Engineering Software.
Other details regarding this course	This course is of predominantly important in industry and needs lots of industrial visits and awareness of what best practices are being followed.

ERGONOMICS

Paper Code	**BM-804**
Course Credits	**4**
Lectures / week	4
Tutorials / week	
Course Description	

Unit-1

Introduction to ergonomics, scope of ergonomics, cost of ignoring ergonomics, result of application of ergonomics, Ergonomics and its areas of application in the work-system, Description of Human-Machine system. Standard format for describing human-machine system.

Unit-II

Muscular Work: Physiological Principles, Sources of Energy, Nervous control of movements and structure of nervous system: Types of nervous system, Neurons, Action potential, Sodium potassium pump, innervations of muscles, Reflex-arc. Dynamics and static muscular work. Field method for assessing physical overload.

Unit-III

Design aspect in ergonomics: Manufacturing work-station design; Determining work-station design parameters, Systematic approach for determining work-station design, determining work-station dimension. Tool evaluation and design: Principles of tool design (General principles, Anatomical concern, Single handle); Attributes of common industrial hand tools, Attributes of common industrial power tools, Tool evaluation check list. Displays and controls.

Unit-IV

Cumulative Trauma Disorder: Work-related Musculoskeletal Disorder: Definition of work-related Musculoskeletal Disorder, Types of WMSDs, Factors affecting WMSDs. Occupational Human Vibration: Characteristics of vibration, Whole-body and hand-arm vibration, Effect of vibration on comfort, health and performance.

Unit-V

Sound and related studies: Definition, evaluation of noise, combining decibels. Levels and Spectra: Sound power level, sound intensity level, numerical problems on sound its measurement

Pre-Requisite Courses (/ Papers):	• Industrial Engineering
Text books:	• Introduction to Ergonomics-R.S. Bridger, McGraw-Hill International Edition.
Reference books:	• Industrial Noise Control-Lewis H-Bell and Douglas H-Bell, Marcel Dekker, INC. • Fitting Tasks to Human, Kroemer, K.H.E. and Grandjean, E. (1997). Philadelphia: Taylor and Francis • The Ergonomic Edge-MacLeod, D. (1995). New-York: Van Nostrand Reinhold.
Course Objective	• Provide students with the basis of occupational ergonomics. • Ergonomic considerations in design, ergonomic consideration in re-design and research basis of ergonomics.
Course Learning Outcomes	• Understand the fundamental of ergonomics (Human Factors) principles of design and evaluation. • Be able to describe an expanded view of ergonomics, which encompasses more than ergonomically related injuries but all parts of assuring that the work-place fits the worker. • Be able to put ergonomic assessments and solutions to practical use in the work place. • Will be capable of initiating evaluations of ergonomic issues and working with an ergonomist.
Computer Usage / Software required:	Adobe Acrobat Reader, Power Point or PP viewer, Video Player.

NUMERIC AND SCIENTIFIC COMPUTING

Paper Code	**BTM – 505**
Course Credits	**4**
Lectures / week	3
Tutorial / week	1
Course Description	**Unit –I** Interpolation with Equal and Unequal Intervals of the Arguments: Newton-Gregory, Gauss, Stirling and Bessel Formulae, Aitken & cubic spline interpolation methods for equal intervals; Newton's divided difference and Lagrange's formulae for unequal intervals; Inverse interpolation using Lagrange's formula, method of successive approximations and double, triple interpolation. **Unit -II** Numerical Differentiation and Numerical Integration**:** Numerical successive differentiation using forward, backward, central differences interpolation formulae, Lagrange's and Newton's divided difference interpolation formula. Numerical integration using Simpson's 3/8 rule, Boole's rule, Weddle's rule, Romberg integration, Gauss-Legendre, Lobatto, Radau and Guass–Chebyshev rules. Errors in Quadrature formulae and numerical double integration. **Unit- III** Numerical Solutions of Algebraic and Transcendental Equations: Bisection, Regula- False position, Newton-Raphson, Graeffe's root-squaring methods for the solution of non-linear algebraic & transcendental equations involving one variable, rate of convergence and error analysis of the methods, Newton-Raphson method for the solution of a system of non-linear equations of two and three variables. **Unit- IV** Numerical Solution of a System of Simultaneous Linear Equations and Curve Fitting**:** Gauss elimination & Gauss-Jordan methods, Ill conditioned linear system, Gauss-Seidel and Crout methods for the solution of a system of linear equations in four unknowns; General curve (linear, quadratic, exponential and other non-linear functions) fitting using method of least squares. **Unit -V** Numerical Solutions of Initial and Boundary Value Problems: Numerical approximate solutions of a system of simultaneous and higher order ordinary differential equations using Taylor's series method, Picard's method and Runge-Kutta fourth order method; Runge-Kutta- Fehlberg method, Euler's modified and Milne's methods; Numerical solution of boundary value problems using finite difference method, shooting method and cubic spline method.
Pre-Requisite Courses (/ Papers):	Engineering Mathematics-I, II & IIT Objective Mathematics and handling the Scientific Calculator
Text books:	• Numerical methods for Scientific and Engineering Computation, M.K. Jain, S.R.K. Iyengar& R. K. Jain, New Age International (P) Ltd. • Introductory Methods of Numerical Analysis, Sastry, S S, Prentice Hall of India Pvt. Ltd.

Reference books:	• Numerical Methods for Engineers Steven C. Chapra& Raymond P. Canale,Tata McGraw Hill Book Co. • Computer Oriented Numerical Methods, Rajaraman; V, Prentice Hall of India Pvt. Ltd. • Elements of numerical analysis, Radhey S. Gupta, Macmillan India Ltd.
Course Objective	• To understand basic Mathematics for solving Engineering Problems
Course Learning Outcomes	• Student will be able to solve and model Engineering problems.
Computer Usage / Software required:	MATLAB, EXCEL, MAXIMA, MATHEMATICA etc.
Other details regarding this course	Problem solving will enable students to solve Mechanical Engineering Problems.

Software Based Machine Design Laboratory II (BTM- 652)
To design and analyze shaft under different loading conditions
To design and analyze journal bearings and select rolling contact bearings based on their industrial uses.
To design various types of power transmission system.
To design and analyze gears
Design of Gear Drives, Materials for gears standards for spur gears. Lubrication & efficiency of a gear drive.

Course Description

Unit-I

Shafts: Stresses in shaft, kinds and causes of failure in shafts. Design calculation for strength and deflection. Design of short and line shafts. Fatigue consideration. Types of couplings. Design of muff and flange coupling. Materials for shafts.

Unit-II

Bearings: Rolling and sliding elements. Nomenclature of journal bearing. Lubrication in loaded journal. Non-dimensional characteristic numbers and their application in design. Heat generation transfer in journal bearing. Thrust bearings. Ball and roller bearings. Types of roller bearing types of ball bearing. Friction in following contact bearings. Equivalent static Load, basic static and dynamic load capacities. Life and selection of roller bearing.

Unit-III

Power Transmission Systems: Types of drives. Comparison. Mechanical drives and their characteristics. Belt drives and types. Design of belts for strength. Theory and design of belt drives. Velocity ratio. Flat belts. V-belts. Selection of belts and belt materials. Surface strength and against bending. Design o chain drives.

Unit-IV

Gear: Types of gears. Modes of gear failures. Force analysis for gears. Design of spur gear based upon contact stress. Beam strength of gear teeth. Lewis form factor and other factors affecting design of gear. Dynamic and static tooth load considerations. Design of spur gears based upon wear. Gear materials.

Unit-V

Design of Gear Drives: Introduction to Gear box, Structural Diagram, Sliding-Mesh Gearing. Design calculation for spur gear (Straight tooth and inclined tooth) reducers. Materials for gears standards for spur gears. Lubrication & efficiency of a gear drive.

Pre-Requisite Courses (/ Papers): *Machine Design-1, Mechanics of solid and Theory of Machines*

Text books:

- *Mechanical Engineering Design by J.E. Shigley, C.R. Mischke & R.G. Buyres. McGraw Hill Book co., 7 e.*
- *Fundamentals of Machine Component Design by R.C. Juvinall, John Wiley &Sons.*

Reference books:

- *Design of Machines Elements by M.F. Spotts, Prentice Hall of India.*
- *Machine Elements by V. Dobrovolsky, MIR Publishers,*
- *Machine Design by Black and Adams, McGraw-Hill Book co.*

	• *Machine Component Design by William Orthwein, Jaico Publishing House.* • *Machine Design by A. Mubeen, Khanna Publication*
Course Objective	• *Reinforce the philosophy that real engineering design problems are open-ended.* • *Give practice in longer open-ended problems using design methodology* *Give practice in longer open-ended problems using design methodology* • *Broaden skills in team work, critical thinking, communication, planning and scheduling through design project*
Course Learning Outcomes	• *Conceptualize alternative concepts, evaluate alternatives, select preferred alternative, and implement the preferred design* • *Use and integrate the fundamentals studied previously towards the goal of analysing and designing mechanical elements to achieve* • *Able to develop and use appropriate analytical models* • *Use appropriate software for design, modelling, and analysis*
Computer Usage / Software required:	*CATIA, PRO-E*

ROBOTICS

Paper Code	**BTM-821 (Elective - Design)**
Course Credits	**4**
Lectures / week	4
Tutorials / week	**--**
Course Description	**Unit-I Fundamentals of Robotics:**

Introduction, Automation and Robotics, A Brief History of Robotics, Laws & Definition of Robot Anatomy & Classification of Robots, Human system & Robotics, Specifications of Robot, Work Volume, Precision of Movement. The Robotics Market, Social Issues and the Future Prospects.

Unit-II Robot Arm Kinematics:

Introduction to Robot Arm Kinematics, Homogeneous Coordinate transformations, Direct & Inverse Kinematics, Composite Homogeneous transformation matrix. Link, joint and parameters. Denavit Harten Berg Notation, D-H Matrix, Kinematic equations. Exercises on Direct & Inverse Kinematics up to six degree of freedom Robots.

Unit-III Robot Grippers:

Classification of End Effectors, Mechanical Grippers, Magnetic gripper, Vacuum gripper, Adhesive gripper, Multi-fingered gripper - Utah, Okada, Stanford, DGIT Hands. Considerations in Gripper Selection - Force Analysis and Design.

Unit-IV Robot Drives, Sensors, Actuators and Control:

Robot drive systems-Hydraulic, Pneumatic & Electric. Robot Sensors - Contact & noncontact type sensors, Force & torque Sensor. Robotic vision system. Basic Control Systems Concepts and Models, Controllers, Control System Analysis.

Unit-V Robot Programming-Languages & Applications in Manufacturing.

Methods of Robot Programming, Lead through Programming Methods. Robot Languages & classification. Programming Exercise on ACL/ATS for Robots Eshed Robots.

Robot Application areas- Material Transfer and Machine Loading/ Unloading, Processing Operations, Assembly and Inspection**,** Future Manufacturing Applications Robots.

Pre-Requisite Courses (/ Papers):	Kinematics & Dynamics of Machines, Instrumentation & Control Engineering.
Text books:	1. "Robotics" by S. K. Saha, Tata McGraw-Hill Pvt. Ltd.

	2. .Industrial Robotics" by M.P Groover, McGraw-Hill International Editions.
Reference books:	1. "Introduction to Robotics": by J.J Craig., Addison Wesley N Delhi. 2. "Robotics" by K. S. Fu., McGraw-Hill International Editions.
Course Objective	To provide an introduction to Robotics including robot classification, design and selection, analysis, sensing and control, and applications in industry.

MECHANICAL ENGINEERING DEPARTMENT
Faculty of Engineering & Technology
Jamia Millia Islamia, New Delhi-110025

M.TECH. (MECH. ENGG.) (Machine Design) III- SEMESTER
Session 2018-19

MTC-301 Project

Date: 16/07/2018

S. No.	Roll No	Name of the Student	Name of the Supervisor	Tentative Topic
1	17MMD001	ANWAR ADIL	Prof. S.M.Muzakkir	MRB, MRC
2	17MMD002	FARHAN KHAN	Prof. Aas Mohd	Mechanism Design, Dimensional Synthesis
3	17MMD003	GOURAV TIWARI	Prof. Mohd. Suhaib	*To be decided*
4	17MMD004	LAUREB RAO	Prof. S.M.Muzakkir	Product Design
5	17MMD005	MD AZHER UDDIN	Dr. Sabah Khan	*To be decided*
6	17MMD006	MOHD FAISAL	Prof. S.M.Muzakkir	Dynamic Design
7	17MMD007	NEETESH KUMAR PANDEY	Prof. Aas Mohd	*To be decided*
8	17MMD008	SAFOORA SHABIR	Dr. Sabah Khan	*To be decided*

The concerned students are required to meet the respective supervisors immediately.

(DR. J. A. USMANI)
HEAD

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MECHANICAL ENGINEERING DEPARTMENT
Faculty of Engineering & Technology
Jamia Millia Islamia, New Delhi-110025

M.TECH. (MECH. ENGG.) (THERMAL ENGG.) III-SEMESTER
Session 2018-19

MTC-301 Project

Date: 16/07/2018

S.No	Roll No	Name of the Student	Name of the Supervisor	Tentative Topic
1	17MMH001	AMBER AMANAT	Prof. M.M. Hasan	*To be decided*
2	17MMH002	AMIR HUSSAIN	Prof. Mohd. Islam	*Nusslet Number enhancement during gas-liquid flow in micro channels*
3	17MMH003	ASHRAF ALAM	Prof. J.A.Usmani	*Green Buildings*
4	17MMH004	MARIYAM ALI	Prof. M.Emran Khan	*Study of heat transfer*
5	17MMH005	MOHAMMED ABDULQAWI OMAR	Dr. Tasmeem A. Khan	*To be decided*
6	17MMH006	MOHD ASIF KHAN	Prof. Abdur Rahim	*To be decided*
7	17MMH007	SATYAM DEWIDEDI	Prof. Abdur Rahim	*To be decided*
8	17MMH008	SAZIA KHANAM	Prof. M.N.Karimi	*Study of Thermal system*
9	17MMH009	MD SHAHID ALAM	Prof. M. M. Hasan	*To be decided*

The concerned students are required to meet the respective supervisors immediately.

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MECHANICAL ENGINEERING DEPARTMENT
Faculty of Engineering & Technology
Jamia Millia Islamia, New Delhi-110025

M.TECH. (MECH. ENGG.) (PRODUCTION & IND. Engg.) III- SEMESTER
Session 2018-19

MTC-301 Project

Date: 16/07/2018

S. No.	Roll No	Name of the Student	Name of the Supervisor	Tentative Topic
1	17MMP001	ABDULLAH FAISAL	Prof. Abid Haleem and Mr. M. Javaid	*To be decided*
2	17MMP002	ANNAYATH MAQBOOL	Prof. Abid Haleem	Supply Chain Management
3	17MMP003	FARMAN SAIFI	Mrs. Halima Begum	*To be decided*
4	17MMP004	MD SAIFULLAH ANSARI	Prof. A.N.Siddiquee	*To be decided*
5	17MMP005	MD SHADAB REZA	Prof. Z.A.Khan	Production and Industrial Engineering
6	17MMP006	MOHD MAJID	Dr. M. Asjad	Reliability Engineering
7	17MMP007	SYED ZEESHANUL HAQUE	Mr. M. Javaid	*To be decided*
8	17MMP008	TAUSEEF AHMAD	Dr. M. Asjad	*To be decided*

The concerned students are required to meet the respective supervisors immediately.

(DR. J. A. USMANI)
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TECHNICAL COMMUNICATION

MEC-902 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

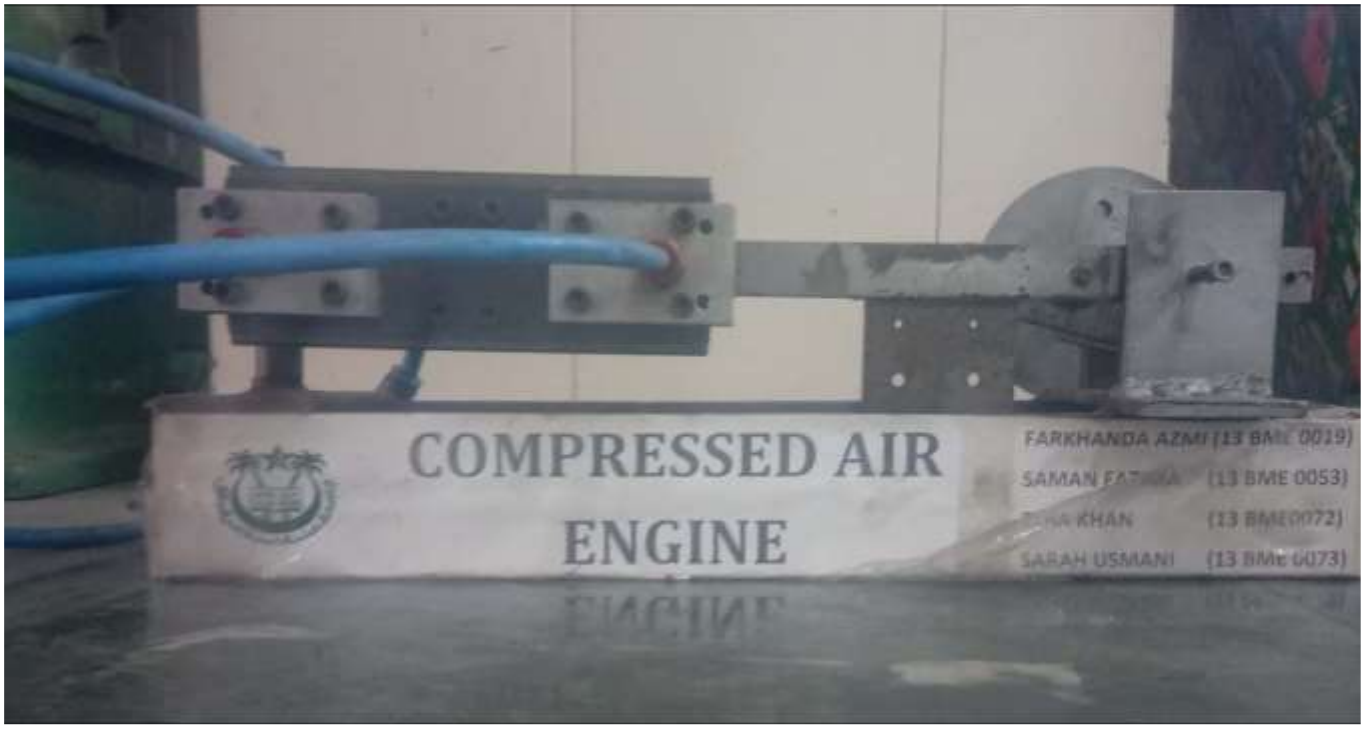
UNIT V Review, Presentation and Effectiveness Measurement

- 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

Textbook

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

MEC 903 IC Engine and Air Pollution



Compressed Air Engine designed and fabricated by Students

I.C. ENGINE AND AIR POLLUTION -MET-903

Contact hours/semester:50 **L-3:T-1:P-0**

UNIT - I

Engine Types and Their Operation: Introduction and Historical perspective – Engine classifications-Engine components - S.I. Engine operation – C.I. Engine operation – Stratified charge engine – working - Rotary Engine –working - Relative merits and demerits.

UNIT - II

Combustion in Spark – Ignition Engines: Introduction – Stages of combustion in SI Engine - Flame front propagation– Factors influencing flame speed - Rate of pressure rise – Heat release analysis - Cyclic variations in combustion, Abnormal combustion and knocking – Effects of detonation - Effect of engine variables on detonation.

UNIT – III

Combustion in Compression – Ignition Engines: Introduction – Stages of combustion in CI Engine - Ignition delay – Factors effecting ignition delay – Knocking in CI Engine – Factors affecting knowing -Types of Diesel Combustion systems – Direct injection systems - Indirect injection systems, comparison of combustion Systems - Combustion in direct injection multi spray -Types of combustion chambers.

UNIT – IV

Engine Performance and Testing: Introduction - Parameters of performance – Engine performance characteristics – variables affecting performance characteristics – heat balance test problems

Fuels and their Characteristics, Alternate Fuels: Necessity of Alternative fuels – Biodiesels – Use of Alcohols – Gaseous fuels -CNG – LPG – Hydrogen and Biogas.

Thermodynamics of combustion – Enthalpy of formation – Heating value of fuel - Adiabatic flame Temperature

Laminar and turbulent flames propagation and structure – Flame stability – Burning velocity of fuels – Measurement of burning velocity – factors affecting the burning velocity.

UNIT – V

Supercharging of Engines, Methods of Supercharging, Turbocharging, Limitations of Turbocharging

Pollutant Formation and Control: Nature and extent of problem-Pollution Norms- Types of pollutants-Nitrogen Oxides – Carbon Monoxide **-**Unburned Hydrocarbons – Particulate Emissions – Measurement of Emissions – Oxides of Nitrogen, carbon monoxide, Unburned Hydrocarbons and smoke – Exhaust gas treatment – Catalytic converters – Thermal reactors .

Recommended Text / Reference Books:

1. Internal Combustion Engine Fundamentals, John. B.Heywood, Mc Graw Hill
2. Internal Combustion Engine and Air Pollution, Obert E.F, Harper and Row Publishers
3. Internal Combustion Engines, V.Ganesan, Tata Mc Graw hill.
4. Internal Combustion Engines, Maleeve V.L, Mc Graw Hill Book Company
5 Internal Combustion Engines, Mathur & Sharma, Dhanpatrai Publishers.
6 IC Engines, Colin R.Ferguson, Allan T.Kirkpatrick, Wiley publishers
7 I C Engines, Combustion & Emissions, B.P.Pundir, Narosa Publications

Course Outcomes Upon successful completion of the course, the students will be able to

CO1: Understand the underlying principles of operation of different I.C engines and components

CO2: Learn the different stages of Combustion in S I engine

CO3: Understand the Combustion phenomena in CI Engine

CO4: Able to demonstrate the Performance characteristics of I C Engines

CO5: Provide knowledge on pollutant formation, control, recent trends etc.

STATISTICS FOR DECISION MAKING

MEC-907 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*

MODERN MANUFACTURING METHODS
MEP-902 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-906 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

Land Fill Gas: From Environment to Energy

MET-909 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)