Indira Gandhi University, Meerpur, Rewari
SCHEME OF STUDIES AND EXAMINATION
M.TECH. (Mechanical)
SEMESTER 1st and 2nd

Scheme effective from 2019-20
<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Course Code</th>
<th>Subject</th>
<th>Credit Pattern (L T P)</th>
<th>Total Credits</th>
<th>Marks of Class work</th>
<th>Theory</th>
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<th>Duration of Exam (Hours)</th>
<th>No of Hours /week</th>
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NOTE:

Examiner will set nine questions in total. Question One will be compulsory and will comprise short answer type questions from all sections and remaining eight questions to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

ELECTIVE - I : Choose any one from the following three papers:

MTME109A - NUMERICAL METHODS & COMPUTING
MTME109B - METHOD ENGINEERING & ERGONOMICS
MTME109C - COMPUTATIONAL FLUID DYNAMICS
## Scheme of Studies and Examination
### M.Tech 1st Year (Mechanical Engineering)
#### Semester 2
CBCS Scheme effective from 2019-20

<table>
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<th>Sl. No</th>
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NOTE: Examiner will set nine questions in total. Question One will be compulsory and will comprise short answer type questions from all sections and remaining eight questions to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

**Elective II : Choose any one from the following three papers:**

- MTME206A - MODELING & SIMULATION
- MTME206B - JIGS & FIXTURE
- MTME206C - TOOL & DIEDESIGN

**Foundation Elective:**

A candidate has to select this paper from the pool of Foundation Electives provided by the University.
General Instructions

1. Seminar

Max.Marks-25

Every candidate will have to deliver a seminar of 30 minutes duration on a topic (not from the syllabus) which will be chosen by him/her in consultation with the teacher of the department. The seminar will be delivered before the students and teachers of the department. A three member committee (one coordinator and two teachers of the department of different branches) duly approved by the departmental council will be constituted to evaluate the seminar. The following factors will be taken into consideration while evaluating the candidate.

Distribution of marks will be as follows:
   1. Presentation 10 marks
   2. Depth of the subject matter 10 marks
   3. Answers to the questions 05 marks

2. Self Study Paper

Max.Marks-25

Objective: This course intends to create habits of reading books and to develop writing skills in a manner of creativity and originality. The students are to emphasis his/her own ideas/words which he/she has learnt from different books, journals and newspapers and deliberate the same by adopting different ways of communication techniques and adopting time scheduling techniques in their respective fields. This course aims: - To motivate the students for innovative, research and analytical work - To inculcate the habit of self study and comprehension - To infuse the sense of historical background of the problems - To assess intensity of originality and creativity of the students. Students are guided to select topic of their own interest in the given area in consultation with their teachers/Incharge/Resource Person.

Instructions for Students

1. Choose the topic of your interest in the given areas and if necessary, seek the help of your teacher.
2. Select a suitable title for your paper.
3. You are expected to be creative and original in your approach.
4. Submit your paper in two typed copies of A4 size 5-6 pages (both sides in 1.5 line spaces in Times New Roman Font size 12).
5. Organize your paper in three broad steps: (a) Introductions (b) Main Body (c) Conclusion
6. Use headings and sub-headings
7. Use graphics wherever necessary
8. Give a list of books/references cited/used
9. The external examiner will evaluate the self-study paper in two ways i.e. Evaluation 15 Marks and Viva-Voce 10 marks.

Distribution of Marks
1. The evaluation is divided into different segments as under: 15 Marks
   i. Selection of Topic - 3 Marks
   ii. Logical Organization of subject matter - 5 Marks
   iii. Conclusions - 5 Marks
   iv. References - 2 Marks
2. Viva-Voce: - 10 Marks
   The external examiner will hold Viva-Voce based on contents of the student’s Self Study Paper focusing upon the description by the Candidate.
UNIT-I
Introduction to New Machining Technologies: Micro electromechanical Systems (MEMS), Non Conventional Machining Process, Comparison of conventional machining processes and new technologies.

UNIT-II

UNIT-III
Ultrasonic machining, Whirling jet machining, fundamental principles, process parameters characteristics, tool design, metal removal rate analysis, important part design, analysis of process. Machining Accuracy and Surface Finish Optimization.

Electro Chemical Machining- Introduction, principles, scheme, process parameters, metal removal rate, Electrochemical grinding: Introduction, tools, process parameters, metal removal rate, Honing, Accuracy and Surface finish Optimization.

UNIT-IV
EDM- Introduction – basic principles, metal removal rate, machining accuracy and surface finish optimization, selection of tool material and dielectric, analysis of process. Wire electric discharge machining: Principle, Process variables.

Reference Books:
1. Manufacturing Sciences by Ghosh & Malik.
2. Newer machining processes; H.S.Shan
3. Advance machining processes by B. Bhushan
UNIT-I

UNIT –II
Curves & Surfaces Geometry and topology, Algebraic & geometric forms of straight lines, circle, bezier curves & B – splines curves, blending functions, Reparametrization, plane surfaces, sixteen point forms, four curves form, ruled surfaces of revolution, Tabulated cylinder, lofted surfaces, bi-cubic surfaces, bezier surfaces, B-splines surfaces, Coons patch.

UNIT –III

UNIT-IV

Text Books:
1. CAD/CAM by M.P. Groover, PHI
2. CAD/CAM Theory and Practice, Teid
3. Understanding CAD/CAM by D.J. Bowman

Reference Book:
1. CAD/CAM Handbook, tiecholz
MTME103- I.C. ENGINES COMBUSTION AND POLLUTION

L T P CREDIT
4 0 0 4

SESSIONAL: 50 Marks
THEORY: 100 Marks
TOTAL: 150 Marks
DURATION OF EXAM: 3 Hrs.

UNIT-I

UNIT-II
Definition of combustion, combustion modes and flame types, review of property relation, Law of thermodynamics, reactant and product mixtures adiabatic flame temperature, chemical equilibrium and product of combustion. Laminar premixed flame, definition principle characteristics, factors, influencing flame velocity and thickness, flammability limits and quenching of laminar flow, ignition, turbulent flames: turbulent flame propagation, flame stabilization

UNIT-III
Burning of carbon, coal combustion, effect of pollutant emissions from premixed combustion and from non-premixed combustion. Detonation, principle, characteristics one-dimensional, detonation velocity, structure of detonation waves.

UNIT-IV
Pollution: Exhaust gases and analysis, orset apparatus, infrared analyzer, determination of air fuel ratios, air pollution and engines.

Text Books:
1. I.C engine Vol. 1 & 2 by Taylor
2. Thermodynamics and Gas Dynamics of IC engines, Vol. 1 & 2 by Horlock and Winter bone.

Reference Books:
1. I.C engine Vol 1 & 2 by Benson and Whitehouse.
2. Thermodynamics analysis of combustion engines, by Campbell
UNIT-I
Introduction to Machine Tools and Mechanisms: General principles of machine tool design, working and auxiliary motions, machine tool drives, hydraulic and mechanical transmission and its elements, general requirements of machine tool design, layout of machine tools. Regulation of Speed and Feed Rates: Purpose, stepped regulation of speed-design of speed box, machine tool drives using multiple speed motors, developing the gearing diagram, step-less regulation of speed and feed rates.

UNIT-II
Machine Tool Structure: Functions and requirements, design criteria, materials used and their properties, static and dynamic stiffness, cross-sectional shapes used for machine tool structures and basic design procedure for the design of beds, columns and other structural elements, model techniques used in design, introduction to Finite Element Method (FEM).

UNIT-III
Guideways and Power Screws: Function and types, design considerations & procedure for slideways, design of power screws.

UNIT-IV

Text Book:
Machine tool design By N.K.Mehta
Design of Machine Tool By S.K.Basu
LIST OF EXPERIMENTS

1. To create a 2-Dimensional Sketch with the help of all geometrical Shapes.
2. To list the coordinate of given diagram
3. To prepare a part programme for facing & turning operation on a CNC Lathe.
4. Prepare part programme for facing & taper turning operation on CNC Lathe in single cut programming in word address format.
5. To create a solid with all of all solid entities of basic solid modeling commands.
6. Practice Boolean operation on solids.
7. Create surface with help of ruled & the tabulated surfaces.
8. Create a surface with the help of a surface of revolution & edgessurface.
List of Experiments:

1. To study the constructional detail & working of two-stroke/ four stroke diesel engine.
2. Analysis of exhaust gases from single cylinder/multi cylinder diesel/petrol engine by Orsat Apparatus.
3. To prepare heat balance sheet on multi-cylinder diesel engine/petrol engine.
4. To find the indicated horse power (IHP) on multi-cylinder petrol engine/diesel engine by Morse Test.
5. To prepare variable speed performance test of a multi-cylinder/single cylinder petrol engine/diesel engine and prepare the curves (i) bhp, ihp, fhp, vs speed (ii) volumetric efficiency & indicated specific specific fuel consumption vs speed.
6. To find fhp of a multi-cylinder diesel engine/petrol engine by Willian’s line method & by motoring method petrol engine.
LIST OF EXPERIMENTS

1. Study and applications of Abrasive Jet Machining.
2. Study and applications of Electrical Discharge M/C
3. Study and applications of Electrochemical Grinding
4. Study and applications of Ultrasonic Machining
5. Study and applications of Electrochemical Machining
6. Study and applications Jet Machining
7. Study and applications wire Electrical Discharge M/C
UNIT-1 ERRORS IN NUMERICAL CALCULATIONS

IN ERPOLATION AND CURV LIFTING

UNIT-2 NUMERICAL DIFFERENTIATION AND INTEGRATION

SOLUTION OF NONLINEAR EQUATIONS
Bracketing methods for locating a root. Initial approximations and convergence criteria. Newton-Raphsen and secant methods. Solution of problems through a structural programming language such as C or Pascal.

UNIT-3 SOLUTION OF LINEAR SYSTEMS
Direct Methods. Gaussian elimination and pivoting. Matrix inversion. UV factorization. Iterative methods for linear systems solution of problems through a structured programming language such as C or Pascal. EIGEN VALUE PROBLEMS
Jacobi. Given’s and Householder’s methods for symmetric matrices. Rutishauser method for general matrices, power and inverse power methods solution of problems through a structured programming language such as C or Pascal.

UNIT-4 SOLUTION OF DIFFERENTIAL EQUATIONS

PARTIAL DIFFERENTIAL EQUATIONS
Solution of hyperbolic. Parabolic and elliptic equations. The eigenvalue problem the power method and the Jacobi’s method for eigen value problems. Solution of problems through a structured programming language such as C or Pascal.
Text Books:
1. Applied Numerical Analysis by Curtis E. Gerald and Patrick Q. Wheatley-
published by Addition Wesley.
Wiley. New York

Reference Books:
2. Introductory Methods of Numerical Analysis by S.D. Sastry. Published by
   Prentice Hall of India.
   H.Mathews. PHI New Delhi
**MTME109B-METHOD ENGINEERING AND ERGONOMICS**

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**DURATION OF EXAM. :3 Hrs.**

**UNIT-I**
Introduction to industrial engineering and productivity, measurement of productivity, Introduction to work study, methods study principles and motion economy, Filming techniques and micro-motion analysis, Introduction to work measurement. Time study, performance allowances, work sampling,

**UNIT-II**
Introduction of Ergonomics, system approach to ergonomic model, Area of study covered under ergonomics, man/machine systems, characteristics of man machine system, limitation of man & machine with respect to each other. Design approach: Work design consideration, General principles for carrying out the physical activities, Design of work place, machine at work place, seat for workplace.

**UNIT-III**
Controls: Criteria for control design, Hand controls and foot controls, Relationship between controls and display instruments, Controls for high precision work (Push buttons, Toggle switches, knobs etc.), Layout of panels and machine Displays:- Types of displays, Design recommendation for quantitative displays.

**UNIT-IV**
**Climates:-** Heat Humidity- Fundamentals of human thermal regulation, measuring the thermal environment, work in hot climate, work in cold climate protection against climatic extremes, effect of climate on performance.

**Noise:-** Terminology, physiological effects of noise, annoyance of noise, speed interference, hearing loss, temporary and permanent threshold shift, effect of noise on performance reduction of noise, personal noise protection.

**Text**

**Books:**
1. Method Engineering study – Krick, S.V.
2. Work study and Ergonics – Suresh Dalela, Saurabh.

**Reference**

**Books:**
UNIT-1  Introduction
History of CFD: Comparison of the three basic approaches in engineering problems solving analytical. Experimental and computational methods. Beam advance in computational techniques.

UNIT-II  Problem formulation
The standard procedure for formulating a problem physical and mathematical classification of problems: types of governing differential equations.

Methods of Discretisation:

UNIT-III  Numerical solution of Heat conduction problems:

UNIT-IV  Numerical solution of fluid flow problems

Books recommended:
Numerical heat transfer and fluid flow by Suhas V. Patankar, taylor and francis.
Computational fluid dynamics by J. Anderson
UNIT 1.
Introduction: Basic classification of welding processes, weldability, weld thermal cycle, metallurgy of fusion welds, solidification mechanism and microstructural products in weld metal, epitaxial, cellular and dendritic solidification, metallurgical changes in weld metal, phase transformation during cooling of weld metal in carbon and low alloy steel, prediction of microstructures and properties of weld metal. Heat affected zone, re-crystallization and grain growth of HAZ, gas metal reaction, effects of alloying elements on welding of ferrous metals.
Welding Arc: Arc efficiency, temperature distribution in the arc; arc forces, arc blow, electrical characteristics of an arc, mechanism of arc initiation and maintenance, role of electrode polarity on arc behaviour and arc stability, analysis of the arc.
Types of electrodes, AWS and Indian system of classification and coding of covered electrode for mild steel, Shielding gases and associated mixtures

UNIT 2.

UNIT 3.
Solid state welding: Introduction, main features and applications of Ultrasonic welding, Friction welding, FRICITION STIR WELDING, FRICITION STIR PROCESSING and Explosive welding.
Welding of plastics: Difficulties in welding of Plastics, Processes for welding of Plastics.
Surfacing and metal spraying: Surfacing methods such as SMAW, MIG, TIG, SAW. Thermal spraying: Introduction, Procedures, Applications, Advantages and Disadvantages.
Under water Welding: Introduction, methods and applications.

UNIT 4.
REFERENCE BOOKS

1. Welding processes & technology by Dr. R.S.Parmar Khanna Publishers
2. Welding Engineering & Technology by Dr. R.S.Parmar Khanna Publishers
4. The Physics of welding by Lancaster; Pergaman Press.
6. Procedure Handbook of ARC welding; Lincoln Electric Co. USA.
8. Welding Technology by Koenigsberger and Adaer; Macmillan.
MTME202- TOTAL QUALITY MANAGEMENT

UNIT 1.
1. TQM Perspective and TQM Implementation:
   Quality, Chain Reaction, Dimensions of Quality, Evolution Of Quality, Quality Control, Quality Assurance, Quality Planning, Quality Improvement, Quality Management, Total Quality Management, Cost Of Quality, Classification of Failure Cost, Reducing Costs, Juran’s Model Of Optimum Quality Costs, Analysis of COQ For Improvement, Analysis Of External Nd Internal Failure Costs, TQM, Elements Of TQM, Leadership For TQM, Demings 14 Points For Top Management, TQM Tools And Techniques, PDSA, Barriers For TQM Implementation

UNIT 2.
2. TQM principles and Strategies:
   Customer Satisfaction & Employee Involvement.
   Service Quality, Features Of Services, The Kano Model, Employee Motivation, Motivation Theory Of Individual Employees, Effective Communications, Training And Mentoring, Recognition And Reward.
   Continuous Process Improvement and Process Approach.
   Juran’s Triology, Kaizan, PDCA, Seven Quality Tools, BPR, Seven Deadly Wastes, ETX Model, Lean Manufacturing, Kanban System, Cellular Manufacturing, Single Piece Flow, Zero Defects

UNIT 3.
3. Statistical Process Control & TQM Tools
   The Seven Quality Control Tools, Standard Normal Distribution, AQL, Seven Management Tools, Benchmarking, QFD, Taguchi’s Design, TPM,FMEA

UNIT 4.
4. Quality Systems
   ISO9000 standard, EMS14001, Quality Awards

5. Supplier Partnership and Performance Measures-
   Importance Of Suppliers, Selection And Standards, Quality Audit, Product Audit, Vendor Rating System, PDCA For Measurements, Performance Measure Design, BSC.
REFERENCE BOOKS:
1. "Total Quality Management" by Oakland (Butterworth - Heinamann Ltd.)
2. "Managing for total quality from Deming to Taguchi and SPC" by Logothetis N. (PHI)
3. "Total Quality Control" by Feigenbaum A.V. (MGH)
4. "Total Quality Management" by Besterfield Dale H (Pearson Education)
5. "A slice by slice guide to TQM" by John Gilbert (Affiliated East West Press).
6. "The TQM toolkit - a guide to practical techniques for TQM" by Waller Jenny, Allen Derek and Burna Andrew (Kogan Page)
MTME204- MECHATRONICS LAB

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SESSIONAL: 50 Marks
Practical: 50 Marks
TOTAL: 100 Marks
DURATION OF EXAM. : 3 Hrs.

1. Study of sensor & Transducers.
2. Study of operational Amplifier
3. Study of Pneumatic & Hydraulic System
4. Study of Mechanical System
5. Study of Computer & Microprocessor equipments
6. Study of Programmable controller
LIST OF EXPERIMENTS IN WELDING

1. To study Heat flow in Welding (Equipment for use-Gas Welding equipment)

2. To study tensile property, Bead Geometry, Hardness of Bead, Micro structure of welding Bead in case of:
   i) MIG Welding
   ii) TIG Welding
   iii) SAW Welding
   iv) Arc welding

3. To study mechanical behaviour (tensile strength, Hardness of Bead, Micro structure of welding Bead, impact strength, corrosion and wear, fatigue behaviour) in case of:
   1. Friction stir welding
   2. Friction stir processing
UNIT-I
Concept of system, system environment, elements of system, system modeling, types of models, Monte Carlo method. System simulation- a management laboratory, advantages & limitations of system simulation, continuous & discrete systems.

UNIT-II
Simulation of Continuous systems: Characteristics of a continuous system, comparison of numerical integration with continuous simulation system. Simulation of an integration formation.
Simulation of discrete systems: Time flow mechanisms, discrete and continuous probability density functions, Generation of random numbers, testing for randomness and for auto correlation, generation of random variates for discrete distribution.

UNIT-III
Simulation of Queuing system: Concept of queuing theory, characteristics of queues, stationary & time dependent queues, Queue discipline, time series analysis, measure of system performance, kendal’s notation, simulation of single sever queues multi-server queues.
Simulation of inventory systems: Rudiments of inventory theory, MRP, in process inventory, necessity of simulation I inventory problems, forecasting & regression analysis, forecasting through simulation.

UNIT-IV
Design of simulation experiments: Length of run, elimination of initial bias, variance reduction techniques, stratified sampling, antipathetic sampling, common random numbers.
Simulation languages: Continuous & discrete simulation languages, block structure, continuous languages, special purpose simulation languages, SIMSCRIPT, GPSS, SIMULA, importance & limitation of special purpose languages.
Text Books:
1. System simulation by Gordon
2. System simulation by Hira
UNIT - I
Degree of freedom & Restrains, Location methods, Design of guide pins & dowel pins,
Location of irregular geometrical product, Calculation of forces & Torque exerted by
machining methods.

UNIT - II
Purpose types and functions of jigs and fixtures, Tool design objectives - Production
devices-Inspection devices-Materials used in Jigs and Fixtures – Types of Jigs - Types of
Fixtures-Mechanical actuation-pneumatic and hydraulic actuation-Analysis of clamping
force-Tolerance and error analysis.

UNIT - III
Jigs, Drill bushes –different types of jigs-plate latch, channel, box, post, angle plate,
angular post, Turnover, pot jigs-Automatic drill jigs-Rack and pinion operated. Air
operated Jigs components. Design and development of jigs for given components.

UNIT - IV
Fixtures for machining and inspection, General principles of boring, lathe, milling and
broaching fixtures- Graining, planning and Shaping fixtures, assembly, Inspection and
welding fixtures- Modular fixtures. Design and development of fixtures for given
component.

Text Books:

Reference Books:
   Company Limited, 5004
5. PSG College of Technology, Coimbatore – Design
   DataHandbook
UNIT -I
Tools Materials and their heat treatment, Mechanism and geometry of chip formation, effect of large and small shear angles on chip thickness and length of shear planes study of cutting forces, friction forces, mean shear strength coefficient of for cutting, method of calculating the metal remove rate. Influence of rake angle side cutting edge & nose radius on cutting forces. Relationship between temperature and hardness of cutting tool materials, Tool geometry of single point and Multipoint Cutting Tool

UNIT - II

UNIT -III
Design and development of dies, Design and development of progressive and compound dies for Blanking and piercing, operations. Bending dies – development of bending dies- forming and drawing dies-Development of drawing dies. Design considerations in forging, extrusion, casting and plastic dies

UNIT- IV
Plastic as a tooling material, commonly used plastic for tooling material, application of epoxy plastic tools, Construction methods of plastic tooling, Metal forming operation with Urethane dies. Calculating forces for Urethane pressure pads.

Text Books:

Reference Books:
5. PSG College of Technology, Coimbatore - Design Data Handbook