

Applied Mathematics - IV

S.E. Sem. IV [MECH/AUTO]

EVALUATION SYSTEM

	Time	Marks
Theory Exam	3 Hrs.	100
Practical Exam	–	–
Oral Exam	–	–
Term Work	–	–

SYLLABUS

1. Fourier Series

Orthogonal and orthonormal functions, Expression for a function in a series of Orthogonal functions. sine and cosine functions and their orthogonality properties. Fourier series of periodic functions with period 2π and $2L$. Dirichlets theorem (only statement). Even and odd functions. Half range sine and cosine series. Parsevalls relations (only statement). Complex form of Fourier series. Fourier integrals with even and odd functions.

2. Partial Differential Equations

Partial differential equation governing transverse vibrations of an elastic string, its formulation and solution using Fourier series.

Heat equation, steady-state configuration for heat flow. Two and Three dimensional Laplace equation.

3. Random Variables

Discrete and continuous random variables, probability mass function and density function. Probability distribution for random variables. Expected value, Variance.

4. Probability Distributions

Binomial, Poisson and normal Distributions.

5. Sampling theory

- Sampling distribution, Test of Hypothesis, Level of significance, critical region. One tailed and two tailed tests. Interval Estimation of population parameters. Large and small samples.
- Test of significance for large samples : Test for significance of the difference between sample mean and population means. Test for significance of the difference between the means of two samples.
- Student's t-distribution and its properties. Test of significance of small samples : Test for significance of the difference between sample mean and population means, Test for significance of the difference between the means of two samples, Chi-square distribution and its properties. Test of the Goodness of fit.

6. Fitting of curves

Least square method : Fitting the straight line and parabolic curve. Bivariate Frequency Distributions, Correlation. Co-variance, Karl Pearson coefficient and Spearman's Rank Co-relation Coefficient (non-repeated and repeated ranks, without proof) Regression Coefficient and lines of regression.

Reference :

1. A Text Book of Applied Mathematics (*P. N. & J. N. Wartikar*)
2. Mathematical Statistics : (*J. N. Kapoor & H.C. Saxena*)
3. Higher Engineering Mathematics (*Dr. B. S. Grewal*)
4. Probability, Statistics and Random Processes (*T. Veerarajan*)
5. Advance Engineering Mathematics (*E. Kreyszig*)



Theory of Machines – I

S.E. Sem. IV [MECH/AUTO]

EVALUATION SYSTEM

	Time	Marks
Theory Exam	3 Hrs.	100
Practical Exam	–	–
Oral Exam	–	–
Term Work	–	25

SYLLABUS

1. Basic Kinematics

- Structure, Machine, Link and its types.
- **Kinematics pairs** : Lower pairs and higher pairs. From closed pairs and force closed pairs, Based on relative motion permitted such as revolute, prismatic, cam, helical, globular.
- **Kinematics chain and Mechanisms** : Grubler's criterion for movability of chains and mechanisms has locked, constraint. Unconstrained based on Grubler's criteria. Limitations of Grubler's Criteria.
- **Inversion of chain** : Study of various mechanisms derived from inversions of following chains with regard to motion of links of mechanisms, motion modification, quality of motion transmission (uniform, non-uniform, SHM, Non-SHM), limiting positions, dead positions, quick return property, applications. Four bar chain (Grashoffian, non-Grashoffian). Single slider crank chain, Double slider crank chain.
- **Special Mechanisms** : Straight line generating Mechanisms: Exact Straight line Generating Mechanisms – Peaucellier's Hart's. Approximate Straight Line Generating. Mechanisms – Watt's Robert's, Evan's and tchebicheff's.

Offset slider crank mechanisms, Pantograph, Hook joint-single and double, Steering gear mechanisms – Ackerman, Davis.

2. Velocity and Acceleration analysis of mechanism (mechanisms up to 6 links).

- Velocity analysis by instantaneous centre of rotation method (Graphical approach).
- Velocity analysis by relative velocity method (Graphical approach). Analysis is extended to find rubbing velocities at joints, mechanical advantage (Graphical approach).
- Velocity and Acceleration – analysis by relative method (mechanisms upto 6 link) including pairs involving Coriolis acceleration (Graphical Approach).

3. Kinetics of Rigid Bodies

- Mass M.I. about centroidal axis and about any other axis. Radius of Gyration. D'Alembert's principle of bodies under rotational motion about a fixed axis and plane motion. Applications of motion of bars, cylinders and spheres only.
- Kinetics of Rigid Bodies : Work and Energy. Kinetic energy in translating motion, Rotation about fixed axis and in general plane motion. Work energy principle and conservation of energy.

4. Static & Dynamic force analysis of plane mechanisms

- Static and dynamic force analysis in slider crank mechanisms (neglecting mass of connecting rod and crank). Engine force analysis. Turning momentum crank shaft.
- Dynamically equivalent systems to convert rigid body to two mass system with and without correction couple.
- Flywheel and its applications, Fluctuation in energy, function of flywheel, estimating inertia of flywheel for reciprocating prime movers and machines.

5. Flexible Connectors

- Belt and Rope Drives – Types of belts, velocity ratio, slip and creep of belt, length of belt for open and cross systems, law of belting, dynamic analysis-driving tensions, centrifugal tension, initial tension, condition of maximum power transmission.
- Chains – types of chains, chordal action, variation in velocity ratio, chain length.

6. Gears

- Law of gearing, Conjugate profile and its graphic construction, Involute and Cycloid gear tooth profile, Construction of Involute profile.
- Path of contact, arc of contact, contact ratio for involutes and cycloid tooth profile, Interference in involutes gears. Critical numbers of teeth for interference free motion. Methods to control interference in involutes gears.
- Static force analysis in gears-spur, bevel, helical, worm and worm gears.

References :

1. Theory of Mechanisms and Machines (*Amitabha Ghosh and A. Kumar Mallik*)
2. Theory of Mechanisms and Machines (*Shigley*)
3. Theory of Machines (*Ballaney*)
4. Theory of Machines (*Rattan*)
5. Kinematics of Machines (*R. T. Hinchkle*) Prentice Hall Inc.
6. Kinematics (*V. M. Fairs*) Mcgraw Hill
7. Mechanism Design : Analysis and Synthesis Vol. I (*A. Erdman and G. N. Sander*) Prentice Hall Inc.
8. Kinematics and dynamics of Planer Mechanisms (*Jeremy Hirissishai*) Mcgraw Hill.



Thermal Engineering
S.E. Sem. IV [MECH/AUTO]

EVALUATION SYSTEM

	Time	Marks
Theory Exam	3 Hrs.	100
Practical Exam	–	–
Oral Exam	–	25
Term Work	–	25

SYLLABUS

1. Combustion of refractive mixtures

Combustion reactions, stoichiometric air A/F, actual A/F ratio. Heat of combustion-open and closed system, Enthalpy and internal energy of reaction. Enthalpy of formation. Calorific value at constant pressure and constant volume. First law for reactive system. Adiabatic combustion temperature. Entropy changes for reacting mixtures.

2. Compressors – Reciprocating

Single stage reciprocating compressor neglecting clearance. Multistaging of compressors. Two stage air compressors, Perfect inter-cooling, Ideal inter cooler pressure. Minimum work, Free air delivered, volumetric efficiency, isothermal and adiabatic efficiency. Effect of clearance volume on F.A.D and volumetric efficiency. Work, power and efficiency calculations.

3. Steam Generator

Fire tube and water tube boiler. Low pressure and High pressure boilers, once through boiler, examples. Important features of HP boilers, Mountings and accessories. Layout of a modern HP boiler. Equivalent evaporation of boilers. Boiler performance. Boiler efficiency.

4. Steam Condensers

Elements of condensing plant. Types of condensers, surface and evaporative condenser. Partial pressure, effect of air leakage, vacuum efficiency. Air pump capacity, Mass of cooling water.

5. Steam Nozzles

Flow through steam nozzle-velocity at exit and condition for maximum discharge, nozzle efficiency.

Steam Turbines

Basic of steam turbine, Classification, compounding of turbine, Impulse turbine-velocity diagram, condition for maximum efficiency. Reaction turbine-velocity diagram, degree of reaction, parson's turbine. Condition for maximum efficiency.

6. Gas Turbine

Application of gas turbine, Actual Brayton cycle, open and closed cycle gas turbine, methods to improve efficiency and specific output, open cycle with intercooling, reheat and regeneration. Effect of operating variable on thermal efficiency and work ratio.

References :

1. Thermal Engineering (*Ballaney*) Khanna Publishers, Reprint 1994.
2. Thermal Engineering (*Kothandraman, Domkundwar, Khajuria, Arrora Dhanpatrai & sons.*)
3. Thermal Engineering (*R .K. Rajput.*)
4. Steam and gas Turbine (*R.K. Yadav*)
5. Thermodynamics (*P.K. Nag*) Tata Mcgraw Hill co. Reprint 1992.
6. Thermodynamics and Heat Engines VoI II (*R. Yadav*) Central Publishing house, Reprint 1994.
7. Turbines, Compressors and Fans (*S. M. Yahya*) Tata Mcgraw Hill.
8. Principle of Thermodynamics (*H. A. Sorensin*) A. Merimal Publications, 1972
9. Applied Thermodynamics for Engineers and Technologists (*Eastop and Mcconky Longman*) 1978.



Production Process – II

S.E. Sem. IV [MECH/AUTO]

EVALUATION SYSTEM

	Time	Marks
Theory Exam	3 Hrs.	100
Practical Exam	–	–
Oral Exam	–	25
Term Work	–	25

SYLLABUS

1. Design of Jig and Fixtures

Need for jigs fixtures, elements of Jigs and fixtures, principles of location, design of locating elements, locating pins support pins spring back, vee blocks, etc. principles of clamping simple hand operated clamps, like screw clamp, lever clamps and other types of clamps. Drill bushes- their types and applications indexing devices, auxiliary elements. Design of drill jigs like plate leaf solid and box types for drilling combined with reaming, spot facing etc. design of milling fixtures such as plain, string, gang and indexing types. Design of turning fixtures.

2. Metal Cutting & Tool Engineering

Features of machining processes, concept of speed and cutting, mechanism of chip formation, concept of shear plane, chip reduction coefficient force analysis. Merchant's circle of cutting forces. Expression for shear plane angle and coefficient of friction in term of cutting forces and tool angles. Merchant's theory-original and modified cutting force and power calculation in machining processes. Growth power, efficiency of machine tools, effect of various parameters on cutting forces, methods of estimating of cutting forces.

3. Economics of metal cutting

Parameters affecting machining cost. Tool life for minimum cost and for maximum Productivity. Measurement of cutting forces : different types of dynamometers and their operations. Tool life definition, mechanism of tool wear and measurement, preliminary and ultimate feature, factors Influencing tool life such as speed, feed, depth of cut, tool material, cutting fluids etc. Surface finish-influence of various parameters cutting tool materials-composition, field of application and manufacture. (carbon tool steel, high speed steel, non-ferrous alloys, carbides and ceramics) coolants-function of coolants, effects on cutting force, tool life and surface finish, Types of coolants, Choice of coolants.

4. Design of cutting Tools

Tool geometry and definition of principles tool angles of single point cutting tools, Design of single point cutting tools, Form tools, Milling : mechanism of process, mean chip thickness, power calculation in milling.. gear milling, standard cutters and limitations, gear hobbing, gear shaping, gear shaving and gear grinding processes.

5. Sheet-metal Working

Elementary treatment of press working operation on presses, press devices and classification of presses, design of blanking, piercing, compound, progressive, bending, forming, and drawing dies, load calculations, development of blanks, scrap strip layout, design of punches, selection of die-sets, stock guides, strippers, pilots, stop, etc. selection of presses, capacities and other details.

6. Rolling and Forming of metal

Principles and process characteristics, Rolling mill-types and capacities, Rolling parameters: Draught, spread, elongation, roll pressure, torque, work and power in rolling., Effect of front and back tension on rolling load, Principles of roll pass design.. Miscellaneous processes like thread rolling, Rolling defects.

Forging, extrusion, rotary swaging (process, types, advantages, limitations and application only)

Reference :

1. Tool Design (*Donaldson*)
2. Jigs & Fixtures (*P H Joshi*)
3. Prod. Tech. (*R. C. Patel & C. G. Gupte*)
4. Workshop Tech. (*W. Aj. Chapman*)
5. Machining Process. (*H. L. Juneja*)
6. Fundamentals of Tool Design (*ASTME*)
7. Metal cutting Theory & Cutting Tool Designing (*V.Arshinov, G Alekseev*)
8. Fundamentals of (*Donaldson*)
9. Principle of Metal cutting (*Sen & Bhattacharya*)
10. Fundamentals of Metal MACHINING (*Geoffery Boothroyd*)
11. Fundamentals of Tool Design (*ASTME*)
12. Introduction to Jigs & Tool Design (*MHA Kempster*)
13. Production Tooling & Equipment (*WA J Parsons*)
14. Die Design Fundamentals By (*J. R. Paquin*)
15. Rolling of Strip, Sheet & Plate (*E C Larke & M.Cook*)
16. Rollpass Design (*British Steel Corporation*)
17. Techniques of Press Working Sheet Metal (*Earry Reed*)
18. Production Technology – (*HMT*)



Material Technology
S.E. Sem. IV [MECH/AUTO]

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	Time	Marks
Theory Exam	3 Hrs.	100
Practical Exam	–	–
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Term Work	–	25

SYLLABUS

1. Lattice Imperfections

Definition, classification and significance of Imperfections Point defects, vacancy, interstitial and impurity atom defects. Their formation and effects.

Dislocation : Edge and screw dislocations Burger's vector. Motion of dislocations and their significance.

Surface defects, Grain boundary, sub-angle grain boundary and stacking faults. Their significance Generation of dislocation Frank Reed source, conditions of multiplication and significance.

Dislocation interactions, Elimination, multicomponent dislocation, Dislocation pile up Dislocation jog dislocation climb

Deformation :

Definition, elastic and plastic deformation and significance in design and shaping

Deformation in single crystal and polycrystalline materials

Mechanism of deformation. Critical stress for deformation

Deformability of FCC, BCC and HCP lattice, slip systems.

Strain Hardening : Definition importance of strain hardening. Dislocation theory of strain hardening.

Effect of strain hardening on engineering behaviour of materials. Recrystallization Annealing. Theory

and stages of recovery. Recrystallization and grain growth. Factors affecting recrystallation

Recrystallation temperature. Hot and cold working theory. Their advantages, limitations and applications.

2. Fracture

Definition and types of fracture.

Brittle fracture. Griffith's theory of fracture. Orowan's modification. Dislocation theory of fracture.

Critical stress and crack propagation velocity for brittle fracture.

Ductile fracture.

Notch effect on fracture.

Fracture toughness.

Ductility transition. Definition and signification. Conditions of ductility transition factors affecting it.

Fatigue Failure :

Definition of fatigue and significance of cyclic stress

Mechanism of fatigue and theories of fatigue failure

Fatigue testing. Test data presentation and statistical evolution. S. N. Curve and its interpretation

Influence of important factors on fatigue. Notch effect surface effect. Effect of pre-stressing, corrosion fatigue thermal fatigue.

Creep :

Effect of temperature on mechanical behaviors of materials.

Definition and signification of creep.

Creep testing and data presentation

Mechanism and types of creep

Analysis of classical creep curve.

3. Theory of Alloys & Alloys Diagrams

Significance of alloying, Definition, Classification and properties of different types of alloys.

Different types of alloys diagrams and their analysis.

Importance of Iron as engineering material, Allotropic forms of Iron, Influence of carbon in Iron-Carbon alloying.

Iron-Iron carbide diagram and its analysis

4. Heat treatment Process

Technology of heat treatment

Classification heat treatment process

Annealing-Principle process, properties and application of full annealing, Diffusion annealing, process annealing and Cyclic annealing, Annealing defects and their remedies.

Normalizing. Hardening heat treatment, Hardening baths, Hardening media, Salt baths, Hardenability. Tempering, Subzero treatment, Austempering, Martempering, Maraging and Ausforming process.

5. Surface Hardening & Diffusion Coating Processes

Hardening and surface Hardening methods. Their significance and applications. Carburizing, Nitriding, Cyaniding, Carbonitriding, induction hardening and flame hardening processes. Diffusion coating processes of Colorizing, Chromising, Siliconizing and Boron diffusion.

6. Effect of Alloying Elements in Steels

Limitation of plain carbon steels. Significance of alloying elements.

Effects of major and minor constituents, Effect of alloying elements on ferrite, carbide, austenite, Effect of alloying elements on phase transformation, decomposition, hardening and tempering.

Classification of tool steels and metallurgy of tool steels and special steels.

Strengthening Mechanism : Theory and applications of strain hardening, Age hardening, Precipitation hardening and Dispersion hardening.

Reference:

1. Mechanical Metallurgy (*G.E. Dieter*) McGraw hill International New Delhi.
2. The Structure and Properties of Materials Vol I (*M.G. Moffet, G.T.W. Pearsall & J. Wulff*.)
3. Materials Science and Engineering (*William D. Callister, Jr. Adapted*) R. Balasubramaniam, Wiley India (P) Ltd.
4. Metallurgy for Engineer (*E.C. Rollason*) - ELBS SOC. And Edward Arnold. London
5. Mechanical Behaviour of Materials – Courtney – McGraw hill International New Delhi.
6. Metallurgy Engineering Part I & II – (*R. A. Higgins & Hodder Stoughton*) London.
7. A text book of Metallurgy (*A.R. Bailey*) Macmillan & Co. Ltd., London.
8. Introduction to solids (*L.V. Azaroff*) McGraw hill International New Delhi.
9. The Structure and Properties of Engineering Alloys (*W.F. Smith*) McGraw hill International, New Delhi.
10. Strengthening of Metals Packner – Reinhild Publishing Corporation, New Delhi.
11. Engineering Physical Metallurgy (*Y. Lakhtin*) Mir Publishers, Moscow.
12. Physical Metallurgy for Engineers (*Donald S. Clarke and Wibur R. Varney*) D. Van Nostrand Co. Inc.
13. Engineering Metallurgy Part I & II (*Raymond A. Higgins*) English Language Book Society & Hodder & Stragton.
14. A text book of Metallurgy, (*A.R. Bailey*) Mc Millan & ltd, London.
15. Structure and Properties of Alloys, (*Robert M. Brick, Robert B. Gordon*) McGraw hill International Book Co.
16. Metallurgy for Engineers, (*E.C. Rollason*) English Language Book Society & Edward Arnold Publisher Ltd.
17. Introduction of Engineering Materials, (*B.K. Agrawal*) McGraw hill Publishing Co. ltd.
18. A text book of Egg. Metallurgy and material technology (*N V Fursule*) satya pub. New Delhi.
19. The Science and Engineering of materials (*Donald R. Askeland*) PWS Publishing Co.
20. Physical Metallurgy (*Avener*)



Industrial Electronics

S.E. Sem. IV [MECH/AUTO]

EVALUATION SYSTEM

	Time	Marks
Theory Exam	3 Hrs.	100
Practical Exam	–	–
Oral Exam	–	–
Term Work	–	25

SYLLABUS

1. Thyristors and their Applications

Introduction, Applications, Symbolic Representations, Specification, Principal of Operation of SCR, Two – Transistor Analogy of SCR, DIAC, TRIAC, Basic Triggering circuits for Thyristers, Rectifier Circuits using SCR.

2. Invertors, Choppers, Converters

Commutation circuits, Inverters : series and parallel, Choppers : Step – up, Morgan’s Jones’s, Single phase and three phase Converters.

3. Solid State Control of D.C. Motors

Introduction, Advantage of Electronic Control, D.C. Motor Speed Control, Speed Control of D.C Shunt Motors using Thyristors, Over-voltage Protection of D.C. Motors, Overload Protection of D.C. Motors, Closed loop control

Solid State Control of A.C. Motors

Introduction, A.C. Motor Control, Speed Control of Motors, Speed Control of A.C. Shunt Motors using Thyristors.

4. Operational Amplifier 741 & ICNE 555

- Introduction, pin diagram, characteristics, specifications
- Applications of IC 741 – Integrator, differentiator, adder, comparator, Instrumentation amplifier
- Application of IC555- Astable, Monostable, Bistable Multivibrators, Timing circuits.

5. Digital Electronics

Binary logic, positive, negative, logic Boolean algebra basic theorem, DeMorgan’s theorem, logic circuits, standard logic gates, universal logic gates, Ex-OR and Ex-NOR (Symbol, equation and truth table). Implementation of Boolean equation using basic gate and universal gate, reduction of Boolean equation using two variable K-Map

6. Introduction to 8085 Microprocessor

Architecture, Instruction sets, simple program writing, Interfacing with memory and Input/Output devices, Applications.

Reference :

1. Thyristors and its applications (*Ramamurthy*) East-West New Delhi.
2. S. K Bhattacharya/S Chatterjee, Tata McGraw Hill Publishing Company Limited
3. Industrial Electronics (*James Humphries*) Leslie Sheets, 4e-Delmar Publication
4. Industrial Electronics (*Biswanth Paul*) PHI
5. Industrial Electronics for Technicians (*J.A. Sam Wilson Joseph Rissi*) Prompt Publication
6. Modern digital electronics (*R..P. Jain*) Mcgraw Hill Publication
7. Op-amp and linear integrated circuits (*Gaikwad*) Eastern Co. edition, PHI
8. Introduction to 8085 Microprocessor (*Gaonkar*) Wiley Eastern
9. Power Electronics (*P.C. Sen*) TATA Mcgrawhill, New Delhi
10. Digital electronics (*Malvino Leach*) TATA Mcgrawhill, New Delhi

