Ministry of Higher Education and
Scientific Research - Iraq
University of Tikrit
College of Engineering
Department of Mechanical Engineering

مواد الامتحان التنافسي لدراسة الماجستير في قسم الهندسة الميكانيكية في جامعة تكريت للعام الدراسي (2025-2026)

ت	المادة	Subject
1	الرياضيات	Mathematics
2	الاهتزازات الميكانيكيه	Mechanical Vibration
3	ميكانيك الموائع	Fluid Mechanics
4	انتقال الحرارة	Heat Transfer
5	ديناميك الحرارة	Thermodynamics
6	هندسه المعادن	Metallurgical Engineering
7	تصميم المكائن	Machines Design
8	عمليات تصنيع	Manufacturing Process

1-Mathematics

Calculus I:

Material Covered
Derivatives
Methods of Derivatives
Integration
Methods of Integration
Power Series, Taylor Polynomials
Taylor’s Series for Sine, Cosine and ex
First-Order Differential Equations, Power series

Calculus II:

Material Covered
Vectors: Vector in Space, Dot and Cross Products
Equations for Lines and Planes in Space
Function of Two and more Variables and Their Derivatives: Partial Derivatives, Chain Rules
Partial Derivatives with Constants Variables
Gradient and Directional Derivatives
Tangent Plane and normal lines
Applications of Partial of Derivative (maximum, minimum and saddle point)
Multiple Integral: Double integral Week 9 Double integral in polar coordinates
Changing Cartesian integrals into Polar integrals
Triple integral (Rectangular, Cylindrical and Spherical)
Complex Number: Addition, Subtraction
Multiplication and Division
Polar representation of Complex Number
Roots

Engineering analysis

Material Covered
First Order Ordinary Differential Equations -Separable Equations - Linear Equations - Exact Equations
Second Ordinary Differential Equations Homogeneous Non- Homogeneous (un-determent Coefficient, Variation of Parameter
Homogeneous Equations Higher Order, The Euler Cauchy Differential Equations,
Power Series Solutions
Simultaneous Linear Differential Equations
Special Functions. -Gamma Function -Euler Beta Function
Laplace Transform The General Method The Transform of Special Functions
The Shifting Theorems The Differentiation and Integration of Transforms
Solving Differential Equations by Laplace Transform
Fourier Series The Euler Formulas Half Range Expansion

Fourier Transform Properties of Fourier Transform Solving Differential Equations by Fourier Transform
Orthogonality Properties of Sine and Cosine
Partial Differential Equations Separation of Variables (Heat Equations)
Partial Differential Equations Separation of Variables (Wave Equations)

2- Vibrations:

Generalized Coordinates
Equation of Motion (Lagrange's Equations)
Lagrange's Equations with Damping
Solution of Equation of Motion (un-damped Single Degree of Freedom)
Damped Single Degree of Freedom (Equation of Motion, damped Natural Frequency damping ratio)
Frequency Response Function (forced vibration Single Degree of Freedom)
Solution of Equation of Motion (damped Single Degree of Freedom, under damped , critical damped)
Response of Single Degree-of-Freedom Systems to impulse Force (impulse response $g(t)$)
Two Degree Of Freedom Systems (Equations Of Motion, Natural frequencies and mode shape)
Orthognality and orthonormality properties of mode shape
Derivation of stiffness matrix by flexibility and stiffness influence Coefficients

3-Fluid Mechanics 1 and 2

Introduction of Fluid Mechanics Principles
Application Areas of Fluid Mechanics.
Classification Of Fluid Flows.
Pressure Variation in Static Fluid.
Fluids at rest stat and pressure applications
Forces on submerged bodies and surfaces
Fluid acceleration and their relative motion
Buoyancy Force

Stability of Floating and Submerged Bodies.
Introduction to fluid In Rigid-Body Motion
Continuity equation
Fluid motion equations and applications

4-Heat Transfer

Force convection, viscos flow, hydrodynamic and thermal boundary layer thickness
Force convection of the laminar flow over flat plate
Relation between fluid friction and heat transfer
Force convection of the turbulent flow over flat plate
Force convection of the laminar and turbulent flow inside tubes and channels
Flow across cylinder and sphere
Flow across banks of tube
Natural convection
Heat exchanger, Log Mean Temperature Difference
Effectiveness NTU method
Heat exchanger design
Radiation heat transfer, Radiation shape factor
Relation between shape factors, heat exchange between gray bodies

5-Thermodynamics I and Thermodynamics Applied:

Second-law of thermodynamics, introduction, statement of second-law of thermodynamics,
Kelvin-Planck statements, Clausius statement, definition of: heat reservoir, heat source, heat sink
Cycle efficiency of a heat engine or thermal efficiency, Carnot cycle, Carnot theorem
Corollary of Carnot's theorem, coefficient of performance for Refrigerators and heat pumps, the thermodynamic temperature scale.
Entropy, introduction, definition of entropy, Inequality of Clausius ,increase of entropy principle
Entropy change for a closed system, general case for change of entropy of a gas, heating a gas at constant volume, heating a gas at constant pressure, reversible adiabatic process, polytropic process.
Steam cycle, ideal Rankin cycle, first law analysis of vapor power cycle, steady- flow energy equations of power plant units, Pump, Boiler, Turbine, Condenser.
Gas power cycles, definition of Air-standard efficiency, air- standard cycles, Carnot cycle.
Constant-volume cycle or Otto cycle, constant pressure cycle or Diesel cycle,
Dual combustion cycle, Brayton cycle or Joule cycle.
Tutorial sheets for example solutions
Gas mixtures, introduction, composition of a gas mixtures mass and mole fractions.
P-V-T behavior of gas mixtures: Ideal and Real gases, Dalton's law of additive pressures, Amagat's law of additive volumes ,properties of gas mixtures: Ideal gases

Chemical Reactions, fuel and combustion, theoretical and actual combustion processes, enthalpy of formation and enthalpy of combustion, first-law analysis of reacting systems, adiabatic flame temperature
Entropy change of reacting systems, second-law analysis of reacting systems.

Introduction to internal combustion engine and IC engine classification
Engine classification and engine components
Principles of SI and CI engine operation, 2-stroke engines, 4-stroke engines
Fuel-Air and Actual Cycles and their Analysis
Engine Design and Performance Parameters
Engine Design and Performance Parameters
Gas exchange systems of ICEs Week 8 Mixture preparation systems in SI engines
Mixture preparation systems in CI engines
Combustion in SI engines
Combustion in CI Engines
IC Engine Testing
IC Engine Testing
Engine boosting systems: Turbo/Super Charging
Engine Emissions & Air Pollution

6-**Engineering Materials**

Structure of solids: Classification of engineering materials, Structure-property relationship in engineering materials
Structure of solids: Crystalline and noncrystalline materials, Miller Indices, Crystal planes and directions, Determination of crystal structure using X-rays.
Structure of solids: Inorganic solids, Silicate structures and their applications. Defects; Point, line and surface defects.
Mechanical properties of materials: Elastic, Anelastic and Viscoelastic behaviour, Engineering stress and engineering strain relationship, True stress - true strain relationship.
Mechanical properties of materials: Review of mechanical properties, Plastic deformation by twinning and slip, Movement of dislocations, Critical shear stress, Strengthening mechanism, and Greep
Equilibrium diagram**: Solids solutions and alloys, Gibbs phase rule, Unary and binary eutectic phase diagram, Examples and applications of phase diagrams like Iron - Iron carbide phase diagram.**
Electrical and magnetic materials: Conducting and resistor materials, and their engineering
application; Semiconducting materials, their properties and applications; Magnetic materials, Soft and hard magnetic materials and applications.
Electrical and magnetic materials: Superconductors; Dielectric materials, their properties and applications. Smart materials: Sensors and actuators, piezoelectric, magnetostrictive and electro strictive materials.

Polymers – types of polymers, commodity and engineering polymers – Properties and applications of various thermosetting and thermoplastic polymers (PP, PS, PVC, PMMA, PET,PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE, Polymers.
various thermosetting and thermoplastic polymers (PP, PS, PVC, PMMA, PET,PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE, Polymers.
Polymers –Urea and Phenol formaldehydes)- Engineering Ceramics – Properties and applications of Al2O3, SiC, Si3N4, PSZ and SIALON –Composites- Classifications- Metal Matrix and FRP - Applications of Composites.
Mechanisms of plastic deformation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), hardness tests, Impact test lzod and charpy, fatigue and creep failure mechanisms.
Materials selection: Overview of properties of engineering materials, Selection of materials for different engineering applications.
Smart or functional materials underly an important class of materials that are used in a range of applications from smart phones to solar energy.
Materials processing in cermaic and composite, case studies

7- Engineering Design I

Introduction to machine design element
Review of stresses and strain
Factor of safety and design codes
Stress concentration
Static failure theories
Fatigue
Shafts, keys and couplings, etc.
Fits and Tolerances
Rolling bearing
Sliding bearing

7-Engineering DesignII

Spur and helical gears
Bevel gears
Worm gears
Screws and fasteners
Design of welded joints
Spring design
Flat belts
V belts
Chains
Clutches and Brakes
Clutches and Brakes

8- MANUFACTURING PROCESSES 1

Production of Metallic Material
Physical &Mechanical Properties of Metallic Material
Machining of Metals
Casting
Metal Forming
Plastics
Metal Connection
Engineering Tolerances

8-MANUFACTURING PROCESSES 2

Metal casting
Types of furnaces
Welding processes
Forming processes
Mechanical machining