THIRD YEAR
FALL SEMESTER

AU-313 COMBUSTION, EMISSION AND POLLUTION

Combustion Theory:
Definitions, chemical equations, First Law, chemical equilibrium/Second Law, computer solution techniques.

Applied Combustion:
Combustion processes in SI and CI engines, combustion characteristics; combustion chamber design for diesel and petrol engines including stratified charge and lean burn; phenomenon of knocking and autoignition.

Gaseous Pollution:
Formation of gaseous exhaust emissions and toxicity; legislation on exhaust emissions; method of control of CO, HC and diesel smoke; engine particulates; Effect of fuel quality on noise and emissions; lean burn and exhaust gas catalysers; oxygen sensors and control; smoke formation; Basic dispersion factors; effect of pollutants on plant and human life.

Noise Pollution:
Vehicle internal and external noise characteristics; vehicle noise legislation; vehicle noise sources; effect of operating parameters on engine and vehicle noise; engine noise; linear engine combustion noise model; noise excitation characteristics of engine combustion systems; tire noise sources and effect of road surface on generated tire noise; traffic noise.

AU-311 MANUFACTURING ENGINEERING-II

Automotive Ferrous, Non-ferrous and Plastic Part Design & Development:
Principles of Sheet-metal die design: Material selection, Concept development, Fundamentals of blanking & piercing, Bending, Forming, and Draw dies; Punch & Die block construction, Pilots, Strippers, Pressure pads, Introduction to press working, types of presses. Introduction to Jigs & Fixtures; Basic design principles, Operation analysis, Design procedures of jigs & fixtures.

Tool Life and Tool Wear:
Determination of machining time and material removal rate for various machining operations, Cutting tool types and their materials; Tool geometry, Tool life, Tool wear, & machinability; Taylor's Tool Life Model, Sharpening & Reconditioning of Cutting Tools.

Metrology:
Standardization: Introduction, product simplification and diversification, interchangeability, selective assembly, Principles, application of standards in design and manufacturing, applying for patents, international and national organizations
Measurements: Operation of linear measuring instruments, slip gauges, length bars, limit gauges, sine bars, reference temperature, limits and fits, hole basis, shaft basis, comparators, Errors in measurements, sensitivity accuracy & variation, measurements of squareness, Flatness, straightness, Roundness, Gear and screw threads, non contact measurement, machine tool metrology, Alignment tests, Level of installation, Spindle straightness. Surface Texture: Roughness, Lay, waviness and flaws, CLA & RMS values, Prediction of roughness in turning, drilling, milling and grinding, measurement of roughness, average values of roughness for various manufacturing operations.

Computer Aided Manufacturing (CAM):
Process Planning & Group technology: Parts classification and coding, hierarchal code, attribute code, hybrid code, introduction to various classification and coding systems, production flow analysis, benefits of group technology, machining cells. The role of process planning in CAD/CAM integration, approaches to process planning; manual approach, variant approach, and generative approach.
CNC programming: G & M codes, 2D manual programming, 3D programming, Coordinate systems and their types, job clamping & dialing, Optimization of machining parameters.

ME-313 SOLID MEACHANICS-II

Stress and Strain Transformations and Relationship
Two-directional stress systems; Mohr's stress circle; principal stresses and planes; Combined bending and torsion; Two-directional strain analysis; Normal and shear strain in terms of coordinate and maximum shear strains; Relationship between elastic constants.

Elastic Strain Energy
Strain energy under direct stress and in pure shear; Strain energy in bending and torsion; Maximum stress due to a suddenly applied load and due to impact; Bending deflection of a beam from an impact, shear deflection; Theorems of Castigliano and Maxwell's theorem.

Theories of Yielding
Maximum Principal Stress Theory; Maximum Principal Strain Theory, Maximum Shear Stress Theory, Total Strain Energy Theory.
Deformation Symmetrical about an Axis
Thick-walled cylinders; Compound cylinders; Shrink fit, rotating disk of uniform thickness.

Bending Stresses
Combined bending and direct stresses. Shear stresses in bending, bending and shear stresses in I-section beams. Asymmetrical bending; Shear stresses in thin-walled open sections and shear center. General case of bending of a thin-walled open section; Bending of initially curved bars; Beams with small radius of curvature.

Statically Indeterminate Beams and Frames
Double integration method; superposition method; Virtual work; Compatibility and equilibrium methods.

Thin plates and shells
Deflection of thin plates, bending of circular plates with symmetrical loading. Plates with uniform loading, solid plate with different loading conditions, Axi-symmetrical thin shells, bending stresses in thin shells.[6]

Tests, Tutorials, Revision etc

MT 332 ADVANCED CALCULUS & LINEAR ALGEBRA

Linear Algebra:
Linearity and linear dependence of vectors, basis, dimension of a vector space, field matrix and type of matrices (singular, non- singular, symmetric, non- symmetric, upper, lower, diagonal tri-diagonal matrix), Rank of a matrix using row operations and special method, echelon and reduced echelon forms of a matrix, determination of consistency of a system of linear equation using rank, transitions matrix, basic concept of tensors, eigen value and eigen vectors of a matrix, Diagonolization, Cayley-Hamiton theorem. Applications of linear algebra in Engineering.

Euclidean Spaces and Transformation:

Geometric representation of vector, norm of vector, Euclidean inner product, projections and orthogonal projections, Euclidean n spaces n properties Cauchy-Schwarz inequality, Euclidean transformations, apply geometric transfom1ations to plane figure, composition or transformations.

Advance calculus:
Define a stationary point of a function of several variables, define local maximum and saddle point for a function of two variables the stationary points of a several variables, obtain higher partial derivatives of simple functions of two or more variables, iterated integrals, double and triple integrations with applications (area, centoroid, moment of inertia, surface area, and volume, use multiple integrals in solutions of engineering problems.

Vector Calculus:
Vector differential operator, directional derivative, gradient, divergence, curl of a vector field, and Laplacian operators with applications. (Solenoid, conservative, etc).

Vector Integrations; Evaluate line integrals along simple paths, apply line integrals to calculate work done, apply Green's theorem in the plane to simple examples, evaluate surface integrals over simple surface, use the Jacobean to transform a problem a new coordinate system, apply Gauss' divergence theorem to simple problems, apply Stokes theorem to simple examples.

HS-304 BUSINESS COMMUNICATION AND ETHICS

Part-1 Communication Skills (Oral):
Definitions and conditions; modes:- verbal, non-verbal, vocal, non-vocal, sender, receiver, encoding, decoding, noise, context, emotional maturity, relationships, etc.; language, perception; non-verbal, body language, physical appearance, cultural differences etc.; personal and interpersonal skills/perceptions; communication dilemmas and problems; public speaking – speaking situation, persuasion.

Part-II Written Communication:
Formal / business letters; memos (brief revision); notice and minutes of meetings; contracts and agreements (basic theoretical knowledge and comprehension); research / scientific reports; tenders (basic theoretical knowledge and comprehension); participating in seminars, interviews, writing and presenting conference papers, solving ielts type papers. (non-examination).

Part-III Engineering / Business Ethics:
Course objective; Need for code of ethics; Type of ethics; involvement in daily life; Problems/conflicts/dilemmas in application. Review of Pakistan Engineering Council Code of Conduct.

AU-314 VEHICLE DYNAMICS

Introductions to vehicle dynamics:
Fundamentals approach to modeling, Dynamic Axle load, Convention in vehicles Dynamics; lumped mass, motion variables, Euler Angle, forces.

Fundamentals of vehicle dynamics:
Weight transfer as a result of grade, acceleration and aerodynamic forces. Tractive force and transmission design. General expression for aerodynamic drag. Drag coefficients for vehicle shapes. Vehicle stability or instability due to drag. Lift and weight transfer. Side load and side winds. Fuel savings as related to drag coefficient.
Concerning; low speed turning, high speed concerning, suspensions effect on concerning.
Ride comfort; excitation sources, vehicle response properties, perception of ride One, two and three-degree of freedom models of front suspension.
Suspensions, Models of front suspension, types of suspension in terms of functioning; active suspension, passive suspensions. MacPherson struts and double A arm geometries. Natural frequencies. Pitch centre and bounce centre. Rear axle suspensions. Roll centre.

Applied Dynamics:
Structure of tires. Rolling resistance and traction. Tread behaviour and functions. Tire slip angles and cornering characteristics. Braking performance

Steering linkages. Function of toe in and toe out. Camber and castor. Moments about the kingpin axis and stability effects. Interaction with geometry changes due to cornering and braking. Oversteer and understeer. Ackerman geometry. Bounce and droop steer and interaction with suspension system

Disc brakes and drum brakes. Airbrake systems. ABS braking and performance. Weight transfer during braking. Yaw moment due to partial malfunction of brakes. Braking-induced instability. Interaction with cornering forces. Roll moments induced by braking. Brake lining performance with temperature.

SPRING SEMESTER

AU-315 DESIGN OF MACHINE ELEMENTS

Fundamental Aspects of Design
Basic Design Process and Design Methodologies; Design Parameters & Operating Conditions; Role of Brain-Storming in design; Recognition of available technologies to the designer; Prototyping and Testing.

Design and Selection of Machine Elements
Joints & fasteners; Knuckle and Cotter Joint; Welded Joints; Threaded and riveted fasteners; Coupling; Flange; Pulleys; Keys and Pins; Helical and Leaf type springs; Belt conveyer and Chains; Selection of Machine elements.

Design of Shaft and Gear
Shaft and columns; Cyclic and shock loads; Torsional stiffness; Critical speeds; Shaft Materials and Design of Circular Shafts under normal and combined loading; Introduction to flexible shafting; Connecting rods and crank shafts; General gear theory; Types of gears; Design of the spur gear; Gear Boxes and Gear Trains in Automotive Applications.

Clutches, Brakes and Flywheel
Clutches; Disc Clutch; Brakes; Disc Brakes; Drum Brakes; Short Shoe External Drum Brakes; Long Shoe External Drum Brakes; Long Shoe Internal Drum Brakes; Band Brakes and Flywheel.

Industrial Design Codes
Introduction to standards and codes; Application of at least one design standard i.e. ASME, BS, ANSI, JIS, DIN or ISO in the Design of Machine Elements and Assemblies.

Lubrication Theory and Bearings
Friction & Wear, Lubrication Theory. Bearings: Types and Materials and Design of Journal and Thrust Slider Bearings, Selection of roller contact Bearings, Seals and Gaskets. Rating, life and reliability of bearings.

Design of Automotive Components
Design of Flywheels, Connecting rod and Crankshaft.

MT-442 NUMERICAL METHODS

Error Analysis
Types of errors (relative, Absolute, inherent, round off, truncation), significant digits and numerical instability, flow chart. Use any Computational tools to Analysis the Numerical Solutions.

Linear Operators
Functions of operators, difference operators and the derivative operators, identities.

Difference Equations
Linear homogeneous and non homogeneous difference equations.

Solution of Non-linear Equations
Numerical methods for finding the roots of transcendental and polynomial equations (Secant, Newton – Raphson Chebyshev and Graeffe's root squaring methods), rate of convergence and stability of an iterative method.

Solution of Linear Equations
Numerical methods for finding the solutions of system of linear equations (Gauss-Elimination, Gauss-Jordan Elimination, triangularization, Cholesky, Jacobi and Gauss – Seidel).

Interpolation &- Curve Fitting
Lagrange's, Newton, Hermit, Spline, least squares approximation. (Linear and non-linear curves).

Numerical Integration & Differentiation
Computation of integrals using simple Trapezoidal rule, 1/3th Simpson's rule, 3/8th Simpson's rule, Composite Simpson's and Trapezoidal rules, computation of solutions of differential equations using (Euler method, Euler modified method, Runge Kutta method of order 4). Numerical Solutions of Partial differential Equations, Optimization problem (Simplex Method). Steepest Ascent and Steepest Descent Methods.

ME-314 FLUID MECHANICS -II

General Theory of Two and Three Dimensional Ideal Fluid Flow:
The velocity field; Eulerian and Lagrangian viewpoints; acceleration of flow particle; irrotational flow; relation between irrotational flow and viscosity; systems and control volumes; potential flow; circulation; stream function and velocity potential, uniform flow; two dimensional source and sink; simple vortex; the doublet; lift and drag forces.

General Theory of Two and Three Dimensional Viscous Fluid Flow:
Stoke’s viscosity law, Navier Stokes equations of motion, two dimensional flow between parallel plates; flow

in a circular pipe; creep flow; reynolds equation; hydrodynamic lubrication in journal bearing.

Boundary Layer Theory:
Boundary layer theory; laminar boundary layer; turbulent boundary layer, boundary layer control; airfoil cascades;

Fluid Machinery:
Similarity relations for turbomachines; specific speed; classification of turbomachines; impulse turbines; propeller type axial-flow reaction turbine, multi bladed reaction turbines; radial flow pumps. performance curves.

Computational Fluid Dynamics:
Introduction; numerical operations for differentiation and integration; programming procedure; simple exercise problems.

ME-306 MECHANICAL VIBRATIONS

Introduction:
Main objectives; elements of a vibratory system; fundamental features in vibratory systems; vector representation of simple harmonic motion, degrees of freedom; damping.

Single Degree of Freedom Systems:
Undamped free vibrations; damped free vibrations.

Two Degree of Freedom Systems:
Undamped and damped free vibrations; Undamped and damped steady state forced vibrations.

Applications:
Equivalent viscous damping; balancing of machines; vibration considerations in machine foundation.

Methods for Finding Natural Frequencies:
Rayleigh method; analytical method and graphical technique; Holzer method.

Vibrations of Elastic Bodies:
Free and forced longitudinal vibrations of a uniform bar; vibrations of a uniform bar with end masses; free and forced lateral vibrations of simply supported thin beams; torsional vibration of circular shaft with single rotor and two rotors, Critical speed of rotating shaft with single rotor and two rotor, Critical speed of rotating shafts; elementary treatment of analogue computation of vibrations, simple cases of electromechanical systems and analogies.

MF-303 APPLIED ECONOMICS FOR ENGINEERS

Introduction:
Engineering economy defined; measures of financial effectiveness; non-monetary factors and multiple objectives; principles of engineering economy.

The Economic Environment:
Consumer and producer goods; measures of economic worth; price, supply, & demand relationship; production; factors of production; laws of return.

Cost Concepts & Analysis:
Sunk & opportunity costs; fixed, variable, and incremental costs; recurring & nonrecurring costs; direct, indirect, and overhead costs; standard costs; breakeven analysis; unit cost of production; cost-benefit analysis; feasibility studies; value analysis in designing & purchasing.

Time Value of Money:
Simple interest; compound interest; cash flow diagrams; interest formulas; nominal versus effective interest rates; continuous compounding.

Depreciation and Depletion:
Purpose of depreciation; types of depreciation; economic life, what can be depreciated?

Comparing Alternatives:
Present economy; selection among machines, materials, processes, and designs, payback period method; present worth method; uniform annual cost method; rate of return method; alternatives having indentical lives. alternatives having different lives.

Production Concepts & Mathematical Models:
Manufacturing lead time, production rate; capacity; utilization; availability; work in process; WIP and TIP ratios.

Linear Programming:
Mathematical statement of linear programming problems; graphic solution; simplex method; duality problems.

Capital Financing and Budgeting:
Types of ownership; types of stock; partnership & joint stock companies; banking & specialized credit institutions.

Industrial Relations:
Labour problems; labour organizations; prevention & settlement of disputes.