MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

DEPARTMENT OF MECHANICAL ENGINEERING

B.Tech. (Mechanical Engineering)
Semester IV

Syllabus

DUGC Convener | Curriculum Committee Convener | SUGB Chairman

Date:

Program: B.Tech. Mechanical Engineering	Department: Mechanical Engineering
Course Code: MET-221	Course Name: Heat Transfer
Credit: 3	L-T-P: 2-1-0

Syllabus

Introduction to heat transfer processes; thermal conductivity of solids, liquids and gases; effect of temperature.

Conduction: Fourier's law; general 3-dimensional conduction equation; different kinds of boundary conditions; nature of differential equations; one dimensional heat conduction with and without heat generation; electrical analogy; heat conduction through composite walls; critical thickness of insulation; heat transfer from finned surfaces; fin efficiency and effectiveness;

Convection: Hydrodynamic and thermal boundary layers; laminar boundary layer equations; forced convection; appropriate non-dimensional numbers; flow over flat plate; similarity solution; effect of Prandtl number; laminar flow through circular pipe; constant heat flux and constant wall temperature conditions; empirical relations.

Natural convection: Dimensional analysis; Grashoff number; boundary layers in external flows (flow over a flat plate only), boundary layers equations and their solutions; heat transfer correlation's.

Heat Exchangers: Different types of heat exchangers; arithmetic and logarithmic mean temperature differences; heat transfer coefficient for parallel, counter and cross flow type heat exchanger; effectiveness of heat exchanger; N.T.U. method; fouling factor.

Thermal Radiation: Plank distribution law, Kirchoff's law; radiation properties, diffuse radiations; Lambert's law, radiation intensity, heat exchange between two black bodies; heat exchange between gray bodies. Shape factor; electrical analogy; reradiating surface; heat transfer in presence of reradiating surface.

Books:

1. Frank P. Incropera and David P. DeWitt "Fundamentals of Heat and Mass Transfer" John Wiley & Sons, New York.
2. J.P. Holman "Heat Transfer" McGraw Hill, Inc., New Delhi.
3. D.S. Kumar "Heat and Mass Transfer" S.K. Kataria& Sons, Delhi.
4. S.C. Arora, S. Domkundwar& A.V. Domkundwar "A Course in Heat and Mass Transfer" DhanpatRai& Co. (P) Ltd., Delhi.

DUGC Convener Curriculum Committee Convener SUGB Chairman

Date:

UG/PG: UG	Department: ME
Course Code: MET-222	Course Name: Kinematics and Dynamics of Machines
Credit: 4	L-T-P: 3-1-0

Syllabus

(i) Mechanisms:Basic Kinematic concepts and definitions, Mechanism, Link, Kinematic Pair, Classification of kinematic pairs, Degrees of freedom, Kinematic chain, Binary Ternary and Quaternary joints and links, Degrees of freedom for plane mechanism, Gruebler's criterion, Inversion of mechanism, Four bar chains and their inversions, Single slider crank chain, Double slider crank chain and their inversion.

(ii) Kinematic Analysis:Determination of velocity using graphical and analytical techniques, Instantaneous centre method, Relative velocity method, Kennedy theorem, Velocity in four bar mechanism, Slider crank mechanism, Rubbing velocity at a Pin-joint, Acceleration Diagram for a slider-crank mechanism, Coriolis's component of acceleration and its application. Gears trains; Simple Compound and epicyclical gear trains; Flat belts and kinematic design of pulleys; V-belts.

(iii) Synthesis of Mechanisms: Introduction, Synthesis, Function, Path and Motion Generation, Limiting Conditions, Graphical and Analytical Synthesis of Four bar and Slider Crank Mechanisms.

(iv) Dynamic Analysis:Applied and constraint forces-static equilibrium conditions-two, three force members, equations of motion, dynamic force analysis, inertia force and inertia torque, D'Alemberts principle, Energy method-Virtual work, the principle of superposition, dynamic analysis in reciprocating engines, equivalent masses, crank shaft torque, turning moment diagrams, flywheels

(v) Balancing:Static and dynamic balancing, balancing of rotating masses, balancing of single and multi-cylinder engines, balancing of reciprocating masses, partial balancing in locomotive engines, balancing linkages, balancing machines-inline and V-engines.

(vi) Control Mechanisms:Governors, types, centrifugal governors, gravity controlled and spring controlled centrifugal governors characteristics – stability- sensitiveness-hunting, isochronisms-effect of friction - controlling force; Gyroscopes, gyroscopic forces and torques, gyroscopic stabilization, gyroscopic effects in automobiles, ships and airplanes

Reference Books

(i) R.L. Norton, Kinematics and Dynamics of Machinery, First Edition in SI, Tata McGraw Hill Publishing Company Ltd, New Delhi

(ii) Theory of Machines and Mechanisms (India Edition) by John J. Uicker Jr., Gordon R. Pennock and Joseph E. Shigley, Oxford University Press

(iii) Mechanism and Machine Theory by J.S.Rao and R.V.Dukipatti, New Age International.

(iv) Theory of Mechanisms & Machines by AmitabhaGhosh, Asok Kumar Mallik, Affiliated East-West Press Pvt Ltd

DUGC Convener Curriculum Committee Convener SUGB Chairman

Date:

UG	Department: Mechanical Engineering
Course Code: MET-223	Course Name: Industrial Engineering
Credit: 3	L-T-P: 2-1-0

Syllabus

- Introduction to work study: Scientific management – Productivity - Advantages of work study to Management.
- Method Study: Introduction - Process charts, Critical Examination, Identification of key activities on process charts, Diagrams and Templates, Therbligs, Micro motion analysis, Memo motion study.
- Principles of Motion Economy: Related to human body, work place, equipment.
- Work Measurement: Work measurement techniques – Rating - Measuring the job – Allowances - Standard time - Synthetic data - Analytical estimating – PMTS ,Work factor, MTM, Activity sampling, Its applications.
- Job analysis, Job Evaluation, Techniques of job evaluation - Merit rating - Incentive plans, Value engineering and analysis.
- Ergonomics: Basics of Ergonomics, Anthropometry.

Reference Books:

1. “Introduction to Work Study”, International LabourOrganisation.

2. “Motion and Time Study; Design and Measurement of Work”, Ralph M. Barnes, John Wiley.

3. “Introduction to Ergonomics”, Bridger, McGraw Hill.

DUGC Convener Curriculum Committee Convener SUGB Chairman

Date:

Program: B.Tech. Mechanical Engineering	Department: Mechanical Engineering
Course Code: MET-224	Course Name: I. C. Engines
Credit: 3	L-T-P: 3-0-0

Syllabus

Ideal and actual cycles of operation, fuels, Combustion and abnormal combustion in SI and CI engines and combustion chambers, carburetors and electronically controlled fuel injection systems for SI engines, fuel injection systems for diesel engines, lubrication systems, cooling systems, supercharging of engines, scavenging, engine performance, testing and exhaust emission characteristics, control of exhaust pollution, current developments including electronic monitoring and control of engines.

Introduction to special engines and computer simulation of two stroke and four stroke engines

Text Books:

1. Stone, R., Introduction to Internal Combustion Engines, The Macmillan press Limited,
2. London, 1992.2.
3. Heywood, J.B., Internal Combustion Engine Fundamentals, McGraw Hill Book Co., NY
4. 1989.3.
2. Obert, E.F., Internal Combustion Engines and Air Pollution, Harper & Row, NY, 1973.4.
3. Ganesan, V., Internal Combustion Engines, Tata McGraw-Hill, New Delhi, 1994.5.
4. Mathur M.L. and Sharma, R.P., A Course in Internal Combustion Engines, DhanpatRai
5. & Sons, New Delhi, 1993.
6. Taylor,C.F., The Internal Combustion in Theory and Practice Vol I & II, The M.I.T.
7. Press

DUGC Convener Curriculum Committee Convener SUGB Chairman

Date:

UG/PG : UG	Department: Mechanical Engineering
Course Code: MET-225	Course Name: Machining Science and Machine Tools
Credit: 4	L-T-P: 3-1-0
Pre-requisite course: Mechanical Workshop	

Syllabus

Unit-1

MATERIALS AND GEOMETRY OF CUTTING TOOLS:Introduction, Desirable Properties of Tool Materials, Characteristics of Cutting Tool Materials, Cutting tool geometry, Chip flow direction, Tool angles specification systems, Cutting parameters and Tool geometry, Index able inserts, chip breakers, Tools of unusual geometry.

Unit-2

MECHANICS OF METAL CUTTING:Merchant's circle diagram- determination of cutting and thrust forces; Coefficient of friction; shear plane angle, Velocity and force relationship, shear stress and strain and strain rate in orthogonal cutting, stress distribution along rake face, theories of Lee and Shaffer's, Oxley's, etc. Cutting force measuring techniques i.e dynamometer.

Unit-3

THERMAL ASPECTS IN MACHINING AND CUTTING FLUID: Regions of heat generation; Heat In the Primary Shear Zone, Heat at the Tool/work Interface, Heat Flow at the Tool Clearance Face, Average shear plane temperature; Average chip-tool interface temperature; method of tool temperature measurement, temperature distribution in tool, Cutting Fluid: Types and composition of cutting fluids, selection of cutting fluid.

Unit-4

TOOL WEAR, TOOL LIFE AND MACHINABILITY: Tool wear mechanisms, Types of tool damage during cutting, Wear and chipping characteristics of different tool materials, Tool wear equations, tool failure criteria, Tool life equations, Effect of process parameters on Tool life, Tool life testing, Machinability, Surface finish and surface integrity.

Unit-5

Machine Tools: types and classification; NC, CNC etc., static, dynamic and thermal consideration in machine tools.

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Date:

CNC MACHINES: Introduction to CNC Systems, Fundamental aspects of machine control, types of CNC machines, ConstructionalFeatures of CNC Machines: Structure, Drive Mechanism, gearbox, Main drive, feed drive, Spindle Motors, Axes motors. Timing belts and pulleys, Spindle bearing, Slide ways, Re-circulating ball screws – Backlash measurement and compensation, linear motion guide ways, Tool magazines, ATC, APC, Chip conveyors. Retrofitting of Conventional Machine Tools, Retrofitting of conventional machines with CNC.

PART PROGRAMMING: Part Program Terminology-G and M Codes – Types of interpolation Methods of CNC part programming – Manual part programming – Computer Assisted part programming – STEP NC programming, CNC part programming using CAD/CAM-Introduction to Computer Automated Part Programming.

ECONOMICS AND MAINTENANCE: Factors influencing selection of CNC Machines, Cost of operation & commissioning of CNC Machines, Maintenance features and Preventive Maintenance of CNC Machines.

Books:

1. Manufacturing Engineering and Technology Kalpakjian
2. Metal cutting theory and practice Bhattacharya
3. Manufacturing Engineering and Technology Groover
4. Metal Cutting Principles Milton C Saw, Oxford
5. Machining Sciences Amitabh Ghosh
6. CNC Machines M.S. Sehrawat and J.S. Narang
7. CNC Programming Handbook Smid Peter Production Technology by HMT
8. "Manufacturing Science" A. Ghosh, and A. K. Mallik, Affiliated East-West Press Pvt. Ltd. New Delhi.

DUGC Convener Curriculum Committee Convener SUGB Chairman

Date:

UG/PG:UG	Department: ME
Course Code: MET-226	Course Name: Mechanics of Solids
Credit: 4	L-T-P: 3-1-0

Syllabus

1. **Fundamental principles of mechanics:** Introduction, principles of mechanics, concept of force & moment, equilibrium conditions, concept of two & three force members, free body diagram.
2. **Introduction to mechanics of deformable bodies:** Analysis of deformable bodies, uniaxial loading & deformation, statically determinate & indeterminate situations, Castigliano's theorem.
3. **Forces & moments transmitted by slender members**: Introduction forces & moments acting on a section of a member, distributed loads & resultant of distributed loads,Differential equilibrium.
4. **Stress & Strain:** Introduction, stress, plane stress, equilibrium of a element in plane stress, Mohr circle representation of a plane stress, general state of stress, Analysis of deformations, strain components, relation between strain & displacement, strain component associated with arbitrary set of axis, Mohr circle representation of plane strain, general state of strain.
5. **Stress-Strain-Temperature relations**: Introduction, tensile test, idealization of stress strain curve, elastic stress strain relation, Thermal strain, complete equations of elasticity, strain energy in an elastic body, criteria of initial yielding.
6. **Torsion:** Introduction, geometry of deformation of a twisted circular shaft, stress strain relations, equilibrium requirements, stresses & deformations in twisted elastic circular shaft, torsion of elastic hollow circular shaft, combined stresses, strain energy due to torsion, yielding in torsion.
7. **Stresses due to bending:** Introduction, deformation in pure bending, stress-strain relations, equilibrium requirements, stresses & deformations in pure bending Stresses due to shear force and bending moment, combined stresses, strain energy due to bending, yielding in bending.
8. **Deflections due to bending:**Introduction, moment-curvature-relations, integration of moment-curvature relations, superposition, Load-deflection differential equation, Energy Methods.
9. **Stability of equilibrium:** Buckling: Introduction, elastic stability, examples of instability, elastic stability of flexible columns.

Books

(i) An Introduction to Mechanics of Solids by S. H. Crandall et al., McGraw-Hill International editions., 1978.

(ii) Engineering Mechanics of Solids by E P Popov and T A Balan, 2nd Edition, Pearson Education, New Delhi.

(iii) Introduction to Solid Mechanics by I. H. Shames, 2nd Edition, 1980, Prentice Hall of India Private Ltd. New Delhi.

(iv) Mechanics of Materials; F. P. Beer, E. R. Johnston and J. T. DeWolf, Third Edition, 2002, McGraw-Hill International Edition

DUGC Convener Curriculum Committee Convener SUGB Chairman

Date:

Program: B.Tech. Mechanical Engineering	Department: Mechanical Engineering
Course Code: MEP-227	Course Name: Heat Transfer Lab
Credit: 1	L-T-P: 0-0-2

List of Experiments

1. Determine the critical heat flux at various bulk temperatures.
2. Determine thermal conductivity of kerosene.
3. To determine the overall hear transfer coefficient.
4. To determine the coefficient of convective heat transfer for air through annular tube heat transfer.
5. To determine effectiveness of a shell and tube heat exchange by general method & NTU method.
6. To determine and compare LMTD, overall heat transfer coefficient and effectiveness of a heat exchanger in [parallel flow and counter flow mode.

DUGC Convener Curriculum Committee Convener SUGB Chairman

Date:

UG/PG	Department: ME
Course Code: MEP-228	Course Name: Dynamics of Machine Lab
Credit: 1	L-T-P: (0-0-2)

Syllabus

1. Kinematics and dynamic analysis of four bar linkage mechanism
2. Kinematics and dynamic analysis of Slider Crank/ Quick return mechanism
3. Analysis of Cam analysis mechanism
4. Analysis of Scotch Yoke Mechanism
5. Analysis of Geneva mechanism
6. Kinematics of Universal Joints – Determination of velocity and acceleration
7. Universal Governors - Determination of sensitivity, effort, etc. for Watt, Porter, Proell, Spring controlled Governors
8. Motorized Gyroscope-Verification of laws -Determination of gyroscopic couple.
9. Whirling of Shaft apparatus with mountings
10. Moment of Inertia of flywheel apparatus
11. Study of Mechanical Power Transmission training system
12. Balancing of rotating and reciprocating masses simulator.
13. Machinery Fault Simulator

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Date:

UG/PG : UG	Department: Mechanical Engineering
Course Code: MEP-229	**Course Name:** Machining Science and Machine Tools Lab
Credit:1	**L-T-P: 0-0-2**
Pre-requisite course: Mechanical Workshop	

List of Experiments

1. Measurement of tool angles of the given single-point cutting tool in the Orthogonal Rake System (ORS) and Machine Tool Reference (MTR) system.
2. (a) Study of lathe dynamometer and (b) determination of cutting force and feed force in orthogonal machining and study their variation with cutting speed and feed.
3. Determination of constants of Taylor' tool life equation using accelerated facing test.
4. CNC Machine Programming and job making.
5. FEM based machine tool design and analysis
6. Machine tool built up using building blocks
7. Manual part programming using G and M codes for Turning, step turning, Taper turning, thread cutting and radius turning on cylindrical components.
8. Programming and Simulation of machining using the following features.(i) Linear and Circular interpolation(ii) Pocket milling, slotting, peck drilling and other fixed canned cycles.
9. Given a component drawing to write the manual part programming and execute on CNC Lathe and Milling Machine.

List of facilities required

1. CNC Lathe with Fanuc® / Siemens® Control
2. CNC Milling Machine with Fanuc® / Siemens® control
3. Master CAM® / Machining module of Hyperworks® software
4. Computer Workstations
5. Dynamometer

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