NATIONAL INSTITUTE OF TECHNOLOGY, HAMIRPUR (HP) – 177 005

B.Tech. Mechanical Engineering, Second Year [4th Semester]

Sr. No.	Course No.	Subject	L	T	P	Hours	Credits
1.	[AM-203]	Differential Equations & Integral Transforms	3	1	0	4	4
2.	[ME-241]	Machine Drawing & Solid Modeling	1	0	3+3	7	4
3.	[ME-242]	Thermal Engineering	3	1	0	4	4
4.	[ME-243]	Non Conventional Machining	3	0	0	3	3
5.	[ME-244]	Turbomachines	3	1	0	4	4
6.	[ME-245]	Internal Combustion Engines and Design	3	1	0	4	4
7.	[ME-242 (P)]	Thermal Lab.	0	0	2	2	2
8.	[ME-243 (P)]	Non Conventional Machining Lab.	0	0	2	2	2
9.	[ME-244 (P)	Turbomachine Lab.	0	0	2	2	2
10.	[ME-245 (P)]	I.C. Engine Lab.	0	0	2	2	2
11.	[ECA - 242]	Extra Curricular Activity – II	0	0	2	2	1
					Total =	**36**	**32**

DIFFERENTIAL EQUATIONS & INTEGRAL TRANSFORMS

AM -203

L	T	P/D	Cr
3	1	0	4

1. **LINEAR DIFFERENTIAL EQUATIONS**: Linear differential equations with constant co-efficients, Complimentary functions and particular integral, Method of variation of parameters, Equations reducible to linear equations with constant co-efficients (Cauchy's and Legendre's linear equations), Simultaneous linear equations with constant co-efficients.

2. **APPLICATION OF LINEAR DIFFERENTIAL EQUATIONS**: Applications of linear differential equations in simple harmonic motion, Oscillations of a spring, simple pendulum, Oscillatory electric circuits, Deflection of beams. Applications of simultaneous linear differential equations to projectiles with resistance and electric circuits.

3. **PARTIAL DIFFERENTIAL EQUATIONS**: Formation and solutions of partial differential equations, Lagrange's linear equation of the first order, Non-linear equations, charpit's method, Homogeneous linear equations with constant co-efficients, Non-homogeneous linear equations, Non linear equations of the second order (Monge's method).

4. **APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS**: Method of separation of variables, Solution of wave equations, Heat flow equations, Laplace's equations and transmission line equation and their application to engineering problems.

5. **SPECIAL FUNCTIONS**: Series solution of Bessel's and Legendre's equation, Bessel's functions and Legendre's polynomials, Recurrence relations, generating functions and orthogonal properties, Equations reducible to Bessel's equation, Ber and Bei functions.

6. **INTEGRAL TRANSFORMS**: Definitions and Types of Integral Transforms, Laplace Transforms, Properties of Laplace transforms and inverse Laplace transforms, Convolution theorem, Application to differential equations, Laplace transform of unit step function, unit impulse function, Periodic functions, Fourier transforms, Finite Fourier Sine and Cosine Transforms, Properties of Fourier Transforms, Z- Transforms, Properties of z-Transforms, Standard Z-Transforms, Applications of Integral Transforms to simple engineering problems.

RECOMMENDED BOOKS

1. Advanced Engienering Mathematics	Erwin Kreyszig
2. Partial Differential Equation for Engineers and Scientists	J.N.Sharma & Kehar Singh
3. Advanced Engineering Mathematics	R.K.Jain & S.R.K.Iyengar

REFERNECE BOOK

1. Elements of Partial Differential Equations	Ian N.Sneddon
2. Differential Equations	Shepley L.Ross
3. Advanced Engineering Mathematics	Chandrika Prasad

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MACHINE DRAWING AND SOLID MODELING

ME – 241

L	T	P/D	Cr
1	0	3+3	4

1. **BASICS OF DRAWING**: Orthographic, Isometric, Sectional Views of Solids, Classification of threading, Fits and Tolerances, Foundation Bolts.

2. **SHAFT COUPLINGS AND JOINTS**: Drawing of muff coupling, flanged coupling, pin type flexible coupling, Drawing of cotter and knuckle joint.

3. **COMPUTER MODELING**: 2-D and 3-D modeling of machine components, fasteners.

4. **TWO-DIMENSIONAL GEOMETRIC TRANSFORMATIONS**: Two-dimensional translation, rotation, scaling, matrix representation and homogeneous co-ordinates, composite transformations, other transformations-reflection, shear transformation between co-ordinate systems.

5. **TWO DIMENSIONAL VIEWING**: The viewing pipeline, viewing co-ordinate reference frame, window to view port coordinate transformations, clipping operations, point clipping, line clipping, polygon clipping.

6. **THREE DIMENSIONAL GEOMETRIC AND MODELING TRANSFORMATION**: Translation, rotation, scaling, reflection, shear, composite transformations, three-dimensional modeling and co-ordinate transformations.

RECOMMENDED BOOKS

1. Machine Drawing — N.D.Bhatt
2. Machine Drawing — Narayana, Kannaiah, & Reddy
3. Machine Drawing — P.S.Gill
4. Machine Drawing — R.K.Dhawan
5. Machine Drawing — G.R.Nagpal
6. Geometrical & Machine Drawing — Parkinson
7. Computer Graphics — Hearn and Baker
8. Geometric Modeling — Anand

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THERMAL ENGINEERING

ME – 242

L	T	P/D	Cr
3	1	0	4

1. **VAPOUR POWER CYCLES**: Review of vapor power cycles, Rankine cycle with reheat, regeneration, bleeding of steam, binary vapor cycles. Deviation of actual cycles from ideal cycles, internal and stage efficiencies, reheat factor.

2. **BOILERS**: Types, water tubes and fire tube boilers, high pressure boilers, mounting and accessories, natural and forced circulation, Boiler draught, Boiler trail and heat balance.

3. **COMPRESSOR**: Single and multistage reciprocating compressor, effect of intercooling, volumetric efficiency, Centrifugal Compressor and its characteristics.

4. **CONDENSER**: Jet and surface condenser, condenser vacuum and vacuum efficiency.

5. **STEAM NOZZLES**: Steady flow energy equation and its application to steam nozzles, isentropic expansion of steam through convergent and divergent nozzles critical pressure, condition for maximum discharge, choking of nozzles, effect of back pressure, super saturated flow through nozzles, flow with friction nozzle efficiency.

6. **STEAM TURBINES**: Principle and working of impulse and reaction turbines, pressure and velocity compounding; velocity triangles for various types, efficiency, diagram efficiency, steam speed to blade speed ratio for optimum performance, losses in steam turbine, performance and governing of steam turbines.

7. **ONE DIMENSIONAL GAS DYNAMICS**: Speed of sound, adiabatic and isentropic steady flows, Mach number, Mach angle, Area velocity relationship, normal shock wave, flow through converging diverging nozzle.

RECOMMENDED BOOKS

1. Thermal Engineering — P.L.Ballaney
2. Thermal Engineering — R.K.Rajput
3. Thermal Power Engineering — R.Yadav
4. Thermal Engineering — Domkundwar
5. Gas Dynamics — Rathakrishanan
6. Gas Dynamics — Yahya

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NON CONVENTIONAL MACHINING

ME-243

L	T	P/D	Cr
3	0	2	4

1. **INTRODUCTION:** Types of advanced manufacturing processes; Evolution, need, and classification of advanced machining processes (AMPs).

2. **MECANICAL TYPE AMPs:** USM, AJM, WJM, AWJM processes: Process principle and elements; Tool design; Mechanism of material removal, parametric analysis; Shape and material applications; Operational characteristics; Limitations.

3. **ADVANCED FINE FINISHING PROCESS:** Abrasive Flow Machining; Magnetic Abrasive Finishing; Magneto Rheological Abrasive Finishing: Process principle, process equipment; Analysis and modeling of finishing mechanism; Parametric analysis; Applications.

4. **CHEMICAL TYPE AMPs:** Process principle and details of Chemical Machining; Photo-Chemical Machining, and Bio-Chemical Machining processes.

5. **ELECTRO CHEMICAL TYPE AMPs:** ECM-Process principle, mechanism of material removal; Kinematics and dynamics of ECM; Tooling design; Choice and analysis of process parameters; Surface finish and accuracy.
6. **THERMAL TYPE AMPs:** EDM, LBM and EBM processes: Working principle; Power circuits; Mechanism of material removal; Process parameters and characteristics; Surface finish and accuracy: Shape and materials applications, limitations.
7. **DERIVED and HYBRID AMPs:** Introduction of processes like rotary ultra sonic machining, electro stream drilling, shaped tube electro machining, wire electro discharge machining, electro chemical grinding, electro chemical honing, electro chemical deburring and electro-chemical spark machining.

RECOMMENDED BOOKS:

1. Modern Machining Processes — Pandey, P.C., Shan, H.S., Tata McGraw-Hill
2. Manufacturing Science — Ghosh, A., Mallik, A.K., Affiliated East-West Press1985
3. Nontraditional Manufacturing Processes — Benedict, G.F., , Marcel Dekker 1987
4. Advance Method of Machining — McGeough, J.A., Chapman and Hall 1988
5. Nonconventional Machining — Mishra, P.K., Narosa Publishing House 1997
6. Advanced Machining Processes — Jain, V.K., Allied Publishers 2002

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TURBOMACHINERY

ME – 244

L	T	P/D	Cr
3	1	0	4

1. **INTRODUCTION:** Definitions of turbo machineries, Euler's turbine equation, classifications, turbines (reversed turbines), axial, radial and mixed flow turbomachines and method of energy transfer in axial, radial and mixed flow machines.

2. **CASCADE THOERY:** Blade terminology, Cascade of blades, Flow angles, Flow deviation, Lift and drag, Losses in cascades, Velocity diagrams, Degree of reaction.

3. **THREE DIMENSIONAL FLOW IN TURBO MACHINES**: Effect of radial pressure gradient, Free vortex flow, Forced vortex flow, Effect of vortex flow on design, Secondary flow, Losses due to secondary flow, Theoretical head capacity relations ill various types of turbo machines, Performance characteristics of different types of turbomachines: head capacity, Efficiency-Capacity, Power- Capacity, Stall, Surge.

4. **CENTRIFUGAL PUMPS, FANS AND BLOWERS**: Inlet section, Pre-rotation, Including section, Prewhirl, Limiting inlet velocity, Flow in impeller channel modification of Euler's theory, Vane and channel shape, Flow in the discharge casing, Volute casing, diffuser performance characteristics, Losses, Regulating blowers, General principles, Adjustable inlet guide vane, Adjustable blade tip, Adjustable disc, Adjustable guide devices, Control of rotation, Self adjustment by characteristics, Mechanical and Hydraulic speed adjustment, Gears etc.

5. **AXIAL FLOW COMPRESSORS:** Construction and working, Velocity diagrams and work done of a stage of axial flow compressors, Degree of reaction, Losses in axial flow compressor stage, Performance of axial flow compressor.

6. **HYDRAULIC TURBINES:** Classification, Euler's equation for turbines, Velocity triangle for single stage axial and radial machines, Impulse and reaction turbines, Pelton, Francis & Kaplan turbine, Power and efficiency calculations, Draft tube, Cavitation, Water turbine governing.

RECOMMENDED BOOKS:

1. Turbo Machine — Shephard
2. Turbines, Compressors & Fans — Yahya
3. Hydraulic Machines — J.Lal.

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INTERNAL COMBUSTION ENGINES AND DESIGN

ME – 245

L	T	P	Cr
4	1	0	4

1. **INTRODUCTION:** Review of Otto, Diesel, dual and Stirling cycle, Comparison of cycles, Actual cycles and their analysis, Classification of IC Engine, two stroke and four stroke cycle engines, Difference between C.I. and S.I. engines, Engine Design and operating parameters.

2. **COMBUSTION OF S.I. ENGINES:** Combustion in S.I. Engines, Flame front propagation, Flame speed, Ignition delay, Abnormal combustion, Combustion chambers for S.I. engines.

3. **COMBUSTION OF C.I. ENGINES:** Combustion in C.I. Engines, Ignition delay, Combustion knock, combustion chamber for C.I. engines, fuel injection testing.

4. **TESTING AND PERFORMANCE** Parameters, Engine power, Engine efficiencies, Type of tests and characteristic curves, Variables affecting performance characteristics, Methods of improving engine performance.

5. **CARBURETION, LUBRICATION, COOLING AND IGNITION SYSTEM:** Simple and complete carburetors, Gasoline Injection, combustion design for S.I. Engines, Friction and lubrication, Types of lubrication systems, Engine cooling Ignition systems, Magneto and Battery ignition systems, Ignition timing.

6. **EMISSION:** Engine economy, Air pollution due to IC engines, Engine emissions, Particulates, Emission control methods, EGR (Exhaust gas recirculation),

7. **FUELS:** Fuels and their properties, Stoichiometric and actual air requirements, Flue gas analysis.

8. **MODELLING OF IC ENGINE SYSTEM:** Classification of models, governing equations for open thermodynamic system.

RECOMMENDED BOOKS

1. Internal combustion Engine — Sharma & Mathur
2. Internal combustion Engine — V.Ganeshan
3 I.C.Engine — Rogowsky
4. I.C.Engine Analysis and Practice — E.F.Obert
5. I.C. Engines and Air Pollution — R. Yadav
6. I.C. Engines Fundamentals — J. B. Heywood

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