MMTP – 101 Advance Mathematics

UNIT- 1

Linear Algebra: Linear transformation, vector spaces, hash function, Hermite polynomial, Heavisite's unit function and error function. Elementary concepts of Modular mathematics.

UNIT -2

Solution of Partial Differential Equation (PDE) by separation of variable method, Numerical solution of PDE (Laplace, Poisson's, Parabolic) using finite difference methods, Elementary properties of FT, DFT, WFT, Wavelet transform, Haar transform.

UNIT 3

Probability, compound probability and discrete random variable, Binomial, Normal and Poisson's distributions, Sampling distribution, elementary concept of estimation and theory of hypothesis, recurred relations.

UNIT 4

Stochastic process, Markov process transition probability transition probability matrix, just and higher order Markov process, Application of Eigen value problems in Markov Process, Markov chain. Queuing system, transient and steady state, traffic intensity, distribution queuing system, concepts of queuing models (M/M/1: Infinity/ Infinity/ FC FS), (M/M/1: N/ Infinity/ FC FS), (M/M/S: Infinity/ Infinity/ FC FS)

UNIT 5

FEM: Variational functionals, Euler Lagrange's equation, Variational forms, Ritz method, Galerkin's method, descretization, finite elements method for one dimensional problems.

Reference Books:

1. Higher Engineering Mathematics by B.V. Ramana, Tata Mc Hill.
2. Advance Engineering Mathematics by Ervin Kreszig, Wiley Easten Edd.
3. Applied Numerical Methods with MATLAB by Steven C Chapra, TMH.
4. Advance Engineering Mathematics, O'Neil, Cengage (Thomson)
5. Introductory Methods of Numerical Analysis by S.S. Shastry,
6. Krishmurthy Finite element TMH
7. Buchanan Finite element analysis(Schaum Outline S) TMH
8. Numerical Solution of Differential Equation by M. K. Jain
9. Numerical Mathematical Analysis By James B. Scarborogh
10. Fourier Transforms by J. N. Sheddon
11. Advance Mathematics for Engr and Sc, Spiegel, Schaum Series, TMH

MMTP –102 Advanced Thermodynamics

Unit 1

Classical Thermodynamics: Concept of classical thermodynamics, review of zeroth, first and second law of thermodynamics. Availability analysis of thermal system and concept of energy conservation.

UNIT 2

Phase and reaction equilibriums: Equilibrium constants .calculation of equilibrium composition of multi components gaseous mixtures.

UNIT 3

Equations of state: Equations of state & calculations of thermodynamics and transport properties of substances, reaction rates of first ,second and higher order reactions, reactions in gaseous, liquid and solid phases .

Unit 4

Equilibrium, real substances and properties, triple point, critical point, Temperature entropy, entropy-enthalpy charts, Vanderwal's equation of state, Claperon's equation, Gibbs phase rule, law of corresponding states.

UNIT 5

Combustion and flames: combustion and flame velocities, Laminar and turbulent flames. Premixed and diffusion flames: their properties and structures. Theories of flame propagation, combustion of solid, liquid and gaseous fuels, combustion of fuel droplets and sprays, combustion systems, combustion in closed and open systems, application to IC engines , boilers, gas turbine, combustors and rocket motors.

Recommended Books:

1. Heat Power and Thermodynamics by M.W.Zemansky (McGraw Hill).
2. Combustion, Flames and explosions of gases, B.Lewis and G.Von Elbe Academic P.
3. Thermal Sciences, Potter, Cengage Learn (Thomson)
4. Engineering thermodynamics by Gurdon Rogers Yon Mayhew.
5. Concept of thermodynamics by Obert (McGraw Hill).

MMTP – 103(A) IC Engines & Alternate Fuels

UNIT 1

SI Engines: Fuels for use in S.I. Engines; Rating of S.I. Engines fuels, carburetors and carburetion, fuel injection systems; Combustion in S.I. Engines-normal and abnormal, detonation, stratification and lean mixture operations. Carburetor replacement by MPFI, Elements of MPFI System like control unit, sensors, switches, Effect on engine performance & Engine Emission.

UNIT 2

Performance & testing of I.C. Engine: Introduction, breathing capacity, pumping losses, friction losses, super charging, performance parameters & their measurements for S.I.E. & C.I.E. Engine, performance maps. Air and sound pollution by engines, remedial measures;

UNIT 3

Non Conventional I.C. Engines : Dual Fuel, Multi Fuel, Stratified charge lean burn variable compression ratio, Rotary Engines, Description, Working and comparison with conventional I.C. Engines.

UNIT 4

Future Fuels for Ignition Engines : Introduction, Necessity for substitute Fuels. Substitute future fuels like Ethanol, Methnol, Bio gas, Hydrogen, Production, Transportation, storage of substitute fuel, performance of engines using these fuels.

Reference Books:

1. A.S. Khatchiian ;Theory of C.I. Engines Vol.1 and 2 IIT Bombay .
2. C.F. Taylor and E.S. Taylor; Internal Combustion Engines ,Stanton
3. P.G. Burman and B.Luca Fuel injection and Engines, Technical Press
4. L.C. Litchy ,Combustion Engines Processes, McGraw-Hill
5. E.F. Obert ,Internal Combustion Engines and Air Pollution , Intext Educational Publishers
6. H.R. Ricardo , The High Speed I.C. Engine, Blackie, London.

MMTP-103(B) Programming and Numerical Methods

Fundamentals of Numerical Methods: Error Analysis, Polynomial Approximations and Interpolations, **Curve Fitting;** Interpolation and extrapolation.

Solution of Nonlinear Algebraic and Transcendental Equations

Elements of Matrix Algebra: Solution of Systems of Linear Equations, Eigen Value Problems.

Numerical Differentiation & Integration: Solution of Ordinary and Partial Differential Equations.

Finite Difference scheme: Implicit & Explicit scheme.

Computer Algorithms: Numerical Solutions for Different thermal Problems, Fuzzy Logic and Neural Network.

Reference Books:

1. An Introduction to Numerical Analysis, AtkinsonK.E., J. Wiley and Sons, 1989.
2. Theory and Problems of Numerical Analysis, Scheid F, McGraw Hill Book Company, (Shaum Series), 1988.
3. Introductory Methods of Numerical Analysis, Sastry S. S, Prentice Hall of India, 1998

MMTP-103(C) Energy Storage System

UNIT-I: Introduction

Necessity of energy storage, different types of energy storage, mechanical, chemical, electrical, electrochemical, biological, magnetic, electromagnetic, thermal, comparison of energy storage technologies

UNIT-II: Energy Storage Systems:

Thermal Energy storage-sensible and latent heat, phase change materials, Energy and exergy analysis of thermal energy storage, Electrical Energy storage-super-capacitors, Magnetic Energy storage Superconducting systems, Mechanical-Pumped hydro, flywheels and pressurized air energy storage, Chemical-Hydrogen production and storage, Principle of direct energy conversion using fuel cells, thermodynamics of fuel cells, Types of fuel cells, Fuel cell performance, Electrochemical Energy Storage Battery, primary, secondary and flow batteries.

UNIT-III: Needs for Electrical Energy Storage:

Emerging needs for EES, more renewable energy-less fossil fuel, Smart Grid uses - the roles of electrical energy storage technologies-the roles from the viewpoint of a utility-the roles from the viewpoint of consumers-the roles from the viewpoint of generators of renewable energy.

UNIT-IV: Types of Electrical Energy Storage systems:

Electrical storage systems, Double-layer capacitors (DLC), Superconducting magnetic energy storage (SMES), supercharging stations, Thermal storage systems, Standards for EES, Technical comparison of EES technologies.

UNIT- V:Design and Applications of Electrical Energy Storage:

Renewable energy storage-Battery sizing and stand-alone applications, stationary (Power Grid application), Small scale application-Portable storage systems and medical devices, Mobile storage Applications- Electric vehicles (EVs), types of EVs, batteries and fuel cells, future technologies, hybrid systems for energy storage.

Text Books:

• Energy Storage-Technologies and Applications by Ahmed Faheem Zobaa,InTech

• Fundamentals of Energy Storage by J.Jensenand B.Sorenson,Wiley-Interscalene,NewYork,

• Energy Storage: Fundamentals, Materials and Applications, by Huggins R.A., Springer.

Reference Books:

• Thermal energy storage: Systems and Applications by Dincer I.and Rosen M. A., Wiley pub.

• Energy Storage: Fundamentals, Materials and Applications, by Huggins R. A., Springer.

• Electric & Hybrid Vehicles by G.Pistoia,Elsevier B.V.

• Fuel cell Fundamentals by R. O'Hayre, S. Cha, W. Colella and F. B. Prinz,WileyPub.

MMTP-104 (A) Fluid Flow & Gas Dynamics

UNIT 1

Fundamental Equations of Fluid and Heat Flow: Governing equations and applications to find solutions to simple fluid and thermal systems

UNIT 2

Potential Flow: Elementary flows, superposition of flow patterns, flow over immersed bodies

UNIT 3

Viscous Flow: Flow over flat plates-laminar and turbulent boundary layers, displacement and momentum thickness, velocity distribution in turbulent flows in smooth and rough boundaries - laminar sub layer

UNIT 4

Compressible Flow of Gases-I: Isentropic and adiabatic flow, stagnation and critical properties, flow through ducts of constant area, Fanno-line and Rayleigh line flows. Fundamental equations and variation in flow properties

UNIT 5

Compressible Flow of Gases-II: Flow with normal shock waves governing equations, Prandtl- Meyer and Rankine-Hugoniot relations

List of Text Books:

1. S.M. Yahya. Fundamentals of Compressible Flows
2. R.W. Fox, A.T. Donald, Philip J. Pritchard. Introduction to Fluid Mechanics, Wiley, 2002
3. P. Balachandran. Fundamentals of Compressible Fluid Dynamics, PHI Learning, 2009

List of Reference Books:

1. Michel A. Saad. Compressible Fluid Flow, Prentice Hall, 2nd Edition, 1993
2. A. Alexandrou. Fluid Mechanics, Prentice Hall, 2001

URLs:

1. http://www.nptel.ac.in
2. https://swayam.gov.in/nc_details/NPTEL

MMTP-104 (B) Nuclear Engineering

Basics of nuclear fission and power from fission

Radioactivity, nuclear reactions, cross sections, nuclear fission, power from fission, conversion and breeding

Neutron transport and diffusion

Neutron transport equation, diffusion theory approximation, Fick's law, solutions to diffusion equation for point source, planar source, etc., energy loss in elastic collisions, neutron slowing down

Multigroup, multiregion diffusion equation, concept of criticality

Solution of multigroup diffusion equations in one region and multiregion reactors, concept of criticality of thermal reactors

Reactor kinetics and control

Derivation of point kinetics equations, inhour equation, solutions for simple cases of reactivity additions, fission product poison, reactivity coefficients

Heat removal from reactor core

Solution of heat transfer equation in reactor core, temperature distribution, critical heat flux

Reactor safety, radiation protection

Reactor safety philosophy, defense in depth, units of radioactivity exposure, radiation protection standards

References:

1. Introduction to Nuclear Engineering (3rd Edition) by John R. Lamarsh, Anthony J.Barrata, Prentice Hall, (2001)

2. Introduction to Nuclear Reactor Theory, by John R. Lamarsh, Addison-Wesley, 1966)

3. Nuclear Reactor Analysis, by James J. Duderstadt and Lewis J. Hamilton, John Wiley (1976)

MMTP-104 (C) Thermal Engineering for Sustainable Technologies

Sustainable Development and Role of Engineers

Introduction, Why and What is Sustainable Development, THE SDFs, Paris Agreement and Role of Engineering, Sustainable Development and the Engineering Profession, Key attributes of the Graduate Engineering

Sustainable Engineering Concepts:

Key concepts – Factor 4 and Factor 10: Goals of sustainability, System Thinking, Life Cycle Thinking and Circular Economy. Green Economy and Low Carbon Economy, Eco Efficiency, Triple bottom Line, Guiding principles of sustainable engineering, Frameworks for sustainable Engineering.

Tools for sustainability Assessment:

Environmental Management System, Environmental Auditing, Cleaner Production Assessment, Environmental Impact Assessment.

Fundamentals of Life Cycle Assessment

Life Cycle Assessment (LCA) Goal and Scope, Life cycle inventory, Life Cycle Impact Assessment, Interpretation and presentation of Results, Iterative Nature of LCA, Methodological Choices, LCI Databases and LCA Software, Strength and Limitations of LCA.Environmental Life Cycle Costing, Social Life Cycle Assessment, Life Cycle Sustainability, LCA Applications in Engineering: Environmental Product Declarations and Product Category Rules, Carbon and Water Foot Printing, Energy systems, Buildings and the Built Environment, Chemical and Chemical Production Food and Agriculture

Introduction to Environmental Economics:

Introduction – What Is Environmental Economics?, Valuing the Environment, Market-based Incentives (or Economic Instruments) for Sustainability, Command-and-Control versus Economic Instruments, A Simple Model of Pollution Control

Integrating Sustainability in Engineering Design:

Problems Solving in Engineering, conventional to Sustainable Engineering Design Process, Design for Life Guidelines and Strategies, Measuring Sustainability, Sustainable Design through sustainable procurement criteria, Case studies on sustainable Engineering Design Process – Sustainable Process Design, Sustainable Production Design Sustainable product design in Electronic Engineering,

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

1. Introduction to Sustainability for Engineers, ToolseeramRamjeawon, CRC Press, 1stEdn., 2020

2. Sustainability Engineering: Concepts, Design and Case studies, Prentice Hall, 1stEdn, 2015

3. System Analysis for sustainable Engineering: Theory and applications, Ni bin Chang, McGraw Hill Publications, 1stEdn., 2010

4. Engineering for Sustainable development: Delivery a sustainable development goals, UNESCO, International Centre for Engineering Education, France, 1stEdn., 2021

5. Introduction to Sustainable Engineering, Rag. R.L. and Ramesh Lakshmi Dinachandran, PHI Learning Pvt. Ltd., 2ndEdn, 2016

MMTP 105 RESEARCH METHODOLOGY AND IPR

UNIT 1

INTRODUCTION TO RESEARCH METHODS

Definition and Objective of Research, Various steps in Scientific Research, Types of Research, Criteria forGood Research, Defining Research Problem, Research Design , Case Study Collection of Primary and Secondary Data, Collection Methods: Observation, Interview, Questionnaires, Schedules,

UNIT 2

SAMPLING DESIGN AND HYPOTHESIS TESTING

steps in Sampling Design, Types of Sample Designs, Measurements and Scaling Techniques - Testing ofhypotheses concerning means (one mean and difference between two means -one tailed and two tailedtests), concerning variance – one tailed Chi-square test.

UNIT 3

INTERPRETATION AND REPORT WRITING

Techniques of Interpretation, Precaution in Interpretation, Layout of Research Report, Types of Reports, Oral Presentation, Mechanics of Writing Research Report

UNIT 4

INTRODUCTION TO INTELLECTUAL PROPERTY

Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights, Innovations and Inventions trade related intellectual property rights.

UNIT 5

TRADE MARKS, COPY RIGHTS AND PATENTS

Purpose and function of trade marks, acquisition of trade mark rights, trade mark registration processes,trademark claims –trademark Litigations- International trademark law

Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the workpublicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer

Text/References Books:

1. C.R. Kothari, Gaurav Garg, Research Methodology Methods and Techniques, New Age International Publishers.

2. Deborah E. Bouchoux, “Intellectual Property: The Law of Trademarks, Copyrights, Patents, and TradeSecrets”, Delmar Cengage Learning.

3. PrabuddhaGanguli, “Intellectual Property Rights: Unleashing the Knowledge Economy”, Tata McGraw Hill Education.

4. Panneerselvam, R., Research Methodology, Prentice-Hall of India, New Delhi,.

5. Ranjith Kumar, Research Methodology – A step by step Guide for Begineers, Sage publisher.

6. D Llewelyn & T Aplin W Cornish, “Intellectual Property: Patents, Copyright, Trade Marks and AlliedRights”, Sweet and Maxwell, .

7. AnanthPadmanabhan, “Intellectual Property Rights-Infringement and Remedies”, Lexis Nexis,

8. Ramakrishna B and Anil Kumar H.S, “Fundamentals of Intellectual Property Rights: For Students,Industrialist and Patent Lawyers”, Notion Press.

9. M.Ashok Kumar and Mohd.IqbalAli :”Intellectual Property Rights” Serials Pub.

MMTP- 106 THERMAL ENGINEERING LAB-I

1. Heat Balance Sheet for spark ignition and compression ignition engines.
2. To find effect of compression ratio on I.C. Engine Performance.
3. Performance test on computerized diesel engine test rig using alternate fuel.
4. To determine effectiveness of a reciprocating compressor.
5. Determination of steam quality in steam generators.
6. To study flow around circular/irregular shaped Body.

MMTP- 107 THERMAL ENGINEERING LAB-II

1. Determination of flow characteristics like coefficient of discharge using flow meters.
2. Measurement of head loss in pipe flow.
3. Study of dynamometers.
4. To perform experimentation to determine effectiveness of surface condenser.
5. Study of different transducers.
6. Flow analysis in converging nozzle