B.Tech Program

in

Mechanical Engineering

By

C.S.J.M.University,Kanpur

Proposed Syllabus by C.S.J.M.University, Kanpur.
Mechanical Engineering

Semester – wise breakup of courses

I SEMESTER		L	T	P	Cr
CHM-S101T	Chemistry-I	3	1	0	3
CHM-S101P	ChemistryLab-I	0	0	3	2
ESC-S101T	Basic Elect. & Elect. Engg.	3	1	0	3
ESC-S101P	Basic Elect. & Elect. Engg. Lab	0	0	3	2
MTH-S101	Mathematics -I	3	1	0	4
PHY-S101T	Physics -I	3	1	0	3
PHY-S101P	Physics Lab-I	0	0	3	2
TCA-S102T	Workshop Concept	1	1	0	2
TCA-S102P	Workshop Practice	0	0	3	3

II SEMESTER					
HSS-S101	Communicative English	3	1	0	4
ISC-S101T	Programming and Computing	3	0	0	3
ISC-S101P	Programming and Computing Lab	0	0	3	2
MTH-S102	Mathematics-II	3	1	0	4
PHY-S102T	Physics-II	3	1	0	3
PHY-S102P	Physics Lab-II	0	0	3	2
TCA-S101	Engineering Drawing	2	0	3	5

III SEMESTER					
ESC – S201	Engineering Mechanics	3	1	0	4
ESC – S202	Thermodynamics	3	1	0	4
MTH – S201	Mathematics III	3	1	0	4
MEE-S201T	Mechanical Design & Drawing	2	0	0	3
MEE-S201P	Mechanical Design & Drawing Lab	0	0	3	2
MEE-S202	Basic Solid Mechanics	3	1	0	4

IV SEMESTER					
HSS-S201	Industrial Management	3	0	0	4
MEE -S203T	Kinematics And Mechanism	3	1	0	3
MEE -S203P	Kinematics And Mechanism Lab	0	0	3	2
MEE-S204	Basic Fluid Mechanics & Rate Processes	3	1	0	4
MEE-S205T	Materials & Mechanical Metallurgy	3	0	0	3
MEE-S205P	Materials & Mechanical Metallurgy Lab	0	0	3	2
MEE-S206	Advanced Solid Mechanics	3	1	0	4

V SEMESTER		L	T	P	Cr
CHM-S301	Chemistry II / MTH-S301 Discrete Mathematics	3	1	0	4
MEE-S301	Dynamics of Machines & Vibrations	3	0	0	4
MEE-S302	Advanced Fluid Mech.	3	0	0	4
MEE-S303	IC Engines, Steam & Nuclear Power	3	0	0	4
MEE-S304	Lab-1, Appl. Mech., Fluid Mech., Vibrations	0	0	3	4

VI SEMESTER					
MEE-S305	Heat Transfer	3	0	0	4
MEE-S306	Production Processes	3	0	0	4
MEE-S307	Design Of Machine Elements	3	1	0	4
MEE-S308	Lab-2, I C Engines, Heat Transfer	0	0	3	4
Departmental Elective		3	0	0	4
SSM-S302	Seminar	0	0	2	2
HSS-S301	Professional Communication	1	1	1	2

VII SEMESTER					
HSS-S401	Industrial Economics	3	0	0	4
MEE-S401T	Computer Aided Manufacturing	3	0	0	3
MEE-S401P	Computer Aided Manufacturing Lab	0	0	3	2
MEE-S402T	Refrigeration & Air-Conditioning	3	0	0	3
MEE-S402P	Refrigeration & A.C Lab	0	0	3	2
MEE-S403	Industrial Management & Production System	3	0	0	4
PRT-S401	B.Tech Project-I	0	0	6	4
SST-S301	Summer Trainning	0	0	2	2

VIII SEMESTER					
MEE-S404	Measurements and Controls	3	0	0	4
MEE-S405	Thermal Turbomachinery & Compressible Flows	3	0	0	4
MEE-S406T	Computer Aided Design	3	0	0	3
MEE-S406P	Computer Aided Design Lab	0	0	3	2
Departmental Elective		3	0	0	4
PRT-S402	B.Tech Project-II	0	0	6	4

List of Departmental Elective Courses

MEE - S501	Robotics	3-0-0-4
MEE - S502	Automobile Engineering	3-0-0-4
MEE - S503	Non Conventional Energy Sources	3-0-0-4
MEE - S504	Operation Research	3-0-0-4
MEE - S505	Unconventional Manufacturing Process	3-0-0-4
MEE - S506	Nuclear Power Engineering	3-0-0-4
MEE - S507	Computer Simulation and Modelling	3-0-0-4
MEE - S508	Metal Forming	3-0-0-4
MEE - S509	Machine Tool Design	3-0-0-4
MEE - S510	Pneumatic Control and Low Cost Automation	3-0-0-4
MEE - S511	Maintenance Management	3-0-0-4
MEE - S512	Finite Element Methods	3-0-0-4
MEE - S513	Composite Materials	3-0-0-4
MEE - S514	Fracture and Fatigue	3-0-0-4
MEE - S515	Optimization Method	3-0-0-4
MEE - S516	Computational Fluid Dynamics	3-0-0-4

Note:
1. Total No. of Lectures in each course should in the range of 40 to 45 per semester if per week three lectures are allotted.

Department of Mechanical Engineering

Detailed Syllabus of B.Tech program courses

Course Code: CHM – S101T   **Breakup:**   3 – 0 – 0 – 3

Course Name: Chemistry - I

Course Details:

UNIT-I - Atoms and Molecules:
Need for wave mechanical picture of atomic structure [Photoelectric effect, de Broglie concept of matter waves], Derivation of schrodinger wave equation [as an example particle moving in unidimensional potential well]

Chemical Bonding- Orbital concepts in bonding, V.B. and M.O. theory, M.O. diagrams, Intermolecular interactions.

UNIT-II - Reaction Dynamics:
Order, Molecularity, Rate law, Integrated rate equations, Methods of determining of order of reaction, Complex reaction kinetics- chain reactions and reversible reactions in detail, Catalysis and enzyme catalysis

UNIT-III - Electrochemistry:
Arrhenius theory of electrolytic dissociation, Transport number, Kohlrausch's law, Solubility product, Redox reaction, Electrochemical and concentration cells.

UNIT-IV- Stereochemistry:
Introduction, Chirality, Enantiomers, Diastereomers, Projection formula of a tetrahedral carbon, Geometrical isomerism, Conformers

UNIT- V- Spectroscopic Techniques:
General introduction to IR, NMR and Mass spectroscopy

UNIT-VI - Organic Reactions:
Introduction, Electron displacement effects, Organic intermediates, Types of reactions [addition, elimination and substitution reactions]

UNIT-VII - Photochemistry:
Photoexcitation of organic molecules, Jablonski diagram, Laws of photochemistry and quantum yield, Some examples of photochemical reactions, Chemistry of vision and other applications of photochemistry.

UNIT-VIII - Transition Metal Chemistry:
Stucture of coordination compounds corresponding to coordination number up to 6, Tpes of ligands, Isomerism [geometrical, optical, ionization, linkage and coordination], Theories of bonding in coordination compounds- crystal field theory, Valence bond theory, Chelation.

UNIT-IX - Laboratory Practical Classes:

Text Books and References:

 Physical Chemistry-   1. P.W. Atkins; 2. Puri & Sharma
Organic Chemistry-   1. Morisson & Boyd; 2. Bahl and Bahl
Inorganic Chemistry- 1. J.D. Lee; 2. R.P. Rastogi
Engineering Chemistry- Shashi Chawla

Course Code: CHM – S101P   **Breakup:**   0 – 0 – 3 – 2

Course Name: Chemistry Lab- I

Course Details:

Exp. 01.	To estimate the strength of the given unknown solution of Mohr's salt (Ferrous ammonium sulphate ($FeSO_4(NH_4)_2SO_4.6H_2O$) using $KMnO_4$ solution as an intermediate.
Exp. 02.	To prepare a sample of p-nitroacetanilide.
Exp. 03.	To prepare a sample of Aspirin.
Exp. 04.	Preparation of Tris (Thiourea) Copper (I) sulphate.
Exp. 05.	Preparation of Hexamine Nickel (II) chloride $[Ni(NH_3)_6]Cl_2$.
Exp. 06.	Estimation of commercial caustic soda: Determination of the amounts of sodium carbonate and sodium hydroxide present together in the given commercial caustic soda.
Exp. 07.	Estimation of calcium ions present in tap water.
Exp. 08.	To determine the partition coefficient of acetic acid between n-butanol and water.
Exp. 09.	To study the photochemical reduction of a ferric salt (Blue printing).
Exp. 10.	To determine the viscosity of a given liquid (30% sugar solution) at room temperature using Ostwald's viscometer.
Exp. 11.	To separate Ag(I), Hg (I) and Pb (II) ions by paper chromatography and calculate their RF values.
Exp. 12.	Understanding reaction kinetics and calculating the rate and order of a reaction.
Exp.13.	To study the kinetics of methyl acetate hydrolysis catalyzed by .5N HCl Solution.

Course Code: ESC-S101T   **Breakup:** 3 –1 – 0 – 3

Course Name: Basic Electrical & Electronics Engineering

Course Details:

Unit – I
Sinusoidal steady state circuit analysis, voltage, current, sinusoidal & phaser presentation single phase AC circuit – behavior of resistance, inductance & capacitance & their combination, impedance concept of power, power factor. Series & parallel resonance – band width & quality factor. Three phase circuits – phase voltage & current, line & phase quantities, phasor diagram, balanced & unbalanced loads, Measurement of R, L, and C.

Unit –II
Network Theory: Network theorems – Thevenin's, Norton, maximum power transfer theorem, star delta transformation, circuit theory concept – mesh & nodal analysis.

Unit – III
Magnetic circuit concepts: self inductance , magnetic coupling analysis of single tuned & double tuned circuit involving mutual inductance , introduction to transformer.

Unit – IV
Basic Instruments, electrical measurement – measurement of voltage , current , power & energy, voltmeters & ammeter , wattmeter , energy meter , three phase power measurement , electronics instrument – multimeter, CRO(analog & digital),An overview of voltage regulator.

Unit – V
Introduction to basic electronics devices – junction diode, BJT, amplifier, op-amps & instrumentation amplifier with mathematical operation.
Number System: Introduction to binary, octal, decimal & hexadecimal systems, representation of negative numbers, 1's, 2's, 9's, 10's complement and their arithmetic.

Text Books and References:

1. W.H.Hayt & J.E. Kemmerly : Engg. Circuit Analysis , Mc Graw Hill.
2. N.N. Bhargava : 'Basic Electronics',Tata McGraw Hill.
3. Malvino, A.P. / "Electronics Principles" / Tata McGraw-Hill / 6th Ed.
4. Morris Mano, "Digital Computer Design" PHI
5. Del Toro : Principles of Electrical Engg. – PHI
6. Boylstad & Neshishkey, "Electronic devices & circuits" , PHI
1. Malvino & Leech "Digital Principle and application", TMH

Course Code: ESC-S101P   **Breakup: 0 –0 – 3 – 2**

Course Name: Basic Electrical & Electronics Engineering Lab

Course Details:

1. Familiarization with the Electronic Instruments.
2. Familiarization with electronic components and Bread board.
3. To verify the Thevenin theorem.
4. To verify the Superposition theorem.
5. Measurement of voltage and frequency with CRO.
6. To study half wave rectifier.
7. To study full wave bridge rectifier.
8. To study full wave bridge rectifier with filter.
9. To study and verify the truth table of different logic gates using digital IC.
10. To study different type of transformer and there operation.
11. To study basic wiring and design a switchboard/extension board.
12. To study the polarity test of a single phase transformer.
13. To study the open & short circuit test of a transformer and calibration losses.
14. To study the load test and efficiency of a single phase transformer.

Course Code: MTH-S101   Breakup: 3 – 1 – 0 – 4

Course Name: Mathematics-I

Course Details:

Unit I
Applications of integrals : Areas between curves, Methods of finding volume : Slicing, solids of revolution , Cylindrical shell , Lengths of plane curves,Areas of Surface of revolution, Moments and Center of mass, Work, Fluid pressure and Forces .
Trapezoidal and Simpson rule , Improper integrals .

Unit II
Sequences: Definition, Monotonic sequences, Bounded sequences, Convergent and Divergent Sequences**.**
Series: Infinite series, Oscillating and Geometric series, their Convergence, Divergence . Tests of Convergence: n^{th} Term test of divergence, Integral test, Comparison Test, Limit Comparison test, Ratio test (Delambert), n^{th} root test (Cauchy root test), Alternating series, Absolute and conditional convergence..
Power Series: Power series and its convergence, Radius and interval of convergence, Term by term differentiation , Term by term integration, Product of power series, Taylor and Maclaurin series , convergence of Taylor series, Error estimates ,Taylor's Theorem with remainder .

Unit III
Vector Calculus: Vector valued functions , Arc length and Unit Tangent vector, Curvature, Torsion and TNB frame **.**
Partial Derivatives: Function of two or more variables (Limit, Continuity, Differentiability , Taylors Theorem) , Partial derivatives, Chain Rule, Partial Derivatives of higher orders, , Maxima and Minima and Saddle Point, Lagrange Multipliers, Exact differential, Jacobian, Leibnitz Theorem.
Directional derivatives, Gradient Vectors, Divergence and Curl , Tangent planes .

Unit III
Multiple Integrals: Double and triple integral, Change of order, Change of variables, Application to area and volume, Dirichlet integral and applications.
Line, surface integrals , Path independence, Statement and problems of Green's, Stoke's and Gauss divergence theorems (without proof).

Text Books and Reference :
 1. G.B.Thomas and R.L.Finney : Calculus and Analytical Geometry
 2. B.S. Grewal, Engineering Mathematics, Khanna Publishers, 2004.
 3. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2005.

Course Code: PHY-S101T   **Breakup: 3 – 1 – 0 – 3**

Course Name: Physics-I

Course Details:

Unit-I: Newton's laws and their applications, Friction, conservative forces and potentials, Work energy theorem, conservation of energy and linear momentum, variable mass system (rocket), impulse, system of particles and collision, Elementary rigid body kinematics, rotation motion, moment of inertia, and Gyroscopic motion.

Unit-II: Rigid body motion, angular momentum, fundamental of classical mechanics, Lagrangian and Hamiltonian formulation.

Unit-III: Motion in non-inertial frames, fractious forces, special theory of relativity, central forces, Gravitation motion under central forces and Kepler's Laws.

Unit-IV: Simple harmonic motion (SHM), small oscillations and resonance; Wave particle duality, de-Broglie matter's waves, Phase and group velocities, Davisson-Germer experiment, Heisenberg uncertainty principle and its applications.

Unit-V: Wave function and its significance, Schrödinger equations (time dependent and independent), Schrödinger's wave equation for particle in one dimensional box, diffraction of X-rays by crystal planes, Bragg's spectrometer, Compton's effect.

Text Books and References:

1. Mechanics: D. S. Mathur
2. A textbook of Mechanics: J. C. Upadhyay
3. Concept of physics (I & II): H. C. Verma
4. Introduction to Mechanics: R. D. Kleppner and J. Kolenkow
5. Physics: Resnick, Halliday and Krane
6. Vector analysis: M. R. Spiegel
7. Classical Mechanics: Goldstien
8. Modern Physics: Author Beiser

Course Code: PHY-S101P   **Breakup: 0 – 0 – 3 – 2**

Course Name: Physics Lab-I

Course Details:

1. Graphical Analysis (Ref. UIET Laboratory Manual)
2. Trajectory of projectile (Ref. UIET Laboratory Manual)
<u>Apparatus Used</u> (Trajectory Apparatus, Metal Balls, Channels, Vernier Callipers, Carbon & Graph Paper)
3. Moment of Inertia of Bicycle wheel (Ref. Book by K. K. Dey, B. N. Dutta)
<u>Apparatus Used</u> (Bicycle Wheel, Masses, Thread, Stopwatch, Meter Scale, Vernier Callipers)
4. Spring Oscillations (Ref. UIET Laboratory Manual)
<u>Apparatus Used</u> (Spring Oscillation Apparatus, Stop Watch, Masses)
5. Coupled Pendulum (Ref. UIET Laboratory Manual)
<u>Apparatus Used</u> (Coupled Pendulum Setup, Stop Watch, Scale)
6. Bifilar Suspension System (Ref. UIET Laboratory Manual)
<u>Apparatus Used</u> (Bifilar Suspension System Setup, Stop Watch, Masses)
7. Frequency of AC Mains by Melde's Method (Ref. Book by K. K. Dey, B. N. Dutta)
<u>Apparatus Used</u> (Electrical Vibrator, String, Pulley, Small Pan, Weight Box & Physical Balance)
8. Kater's(Reversible) Pendulum (Ref. Book by K. K. Dey, B. N. Dutta)
<u>Apparatus Used</u> (Kater's Pendulum, Stop Watch)
9. Inertia Table (Ref. Book by K. K. Dey, B. N. Dutta)
<u>Apparatus Used</u> (Inertia Table, Stop Watch, Vernier Callipers, Split Disc, Balancing Weights, and Given Body(Disc))

Course Code: TCA – S102T **Breakup:** 1 – 1 – 0 – 2

Course Name: Workshop Concepts

Course Details:

Historical perspectives; Classification of Manufacturing process.

Machining: Basic principles of lathe machine & operations performed on it. Basic description of machines & operations of shaper-planer, drilling, milling, grinding.Unconventional machining processes , Machine tools.

Casting processes:pattern & allowances. Moulding sands & its desirable properties. Mould making with the use of a core. Gating system. Casting defects & remedies. Cupola furnace. Die-casting & its uses.

Metal forming: Basic metal forming operations & uses of such as-forging, rolling, wire& tube drawing/making & extrusion, & its products/applications, press work & die & punch assembly, cutting & forming, its application. Hot working vs Cold working. Powder metallurgy: powder metallurgy process & its applications, plastic-products manufacturing, galvanizing & electroplating.

Welding: Importance & basics concepts of welding, classification of welding processes. Gas welding, types of flames, Electric arc welding. Resistance welding. Soldering & brazing and its uses.   Modern   trends   in   manufacturing,   Automation.   Introduction   to NC/CNC/DNC,FMS,CAD/CAM,CIM and factory of future.

Text Books and References:
1. Chapman,W A J & Arnold ,E "Workshop Technology ; vol. I,II&III" Viva Low Priced Student Edition.
2. Raghuwanshi,B S "Workshop Technology ; vol. I&II" Dhanpat Rai & Sons
3. Chaudhary, Hajra "Elements of Workshop Technology ; vol. I&II" Media Promoters & Publishers.

Course code: **TCA – S102P**   **Breakup:**   **0 – 0 – 3 – 3**

Course Name: **Workshop Practice**

Course Details:

1. Foundry (1 turn)
2. Welding (3 turns)
   a. Gas Welding (1 turn)
   b. Arc Welding (2 turns)
      (i). Lap Joint (1 turn)
      (ii) Butt Joint (1 turn)
3. M/C Shop (4 Turns)
4. Fitting & Sheet Metal Work (1 turn+1 turn)
5. Carpentry Shop(1 turn)
6. Black-smithy shop(1 turn)

Text Books and References:
1. Chapman,W A J & Arnold ,E "Workshop Technology ; vol. I,II&III" Viva Low Priced Student Edition.
2. Raghuwanshi,B S   "Workshop Technology ; vol. I&II" Dhanpat Rai & Sons .
3. Chaudhary, Hajra "Elements of Workshop Technology ; vol. I&II" Media Promoters & Publishers.

Course Code: HSS-S101   **Breakup: 3 –1 – 0 – 4**

Course Name: Communicative English

Course Details:

Unit 1: Basics of Technical Communication: Technical Communication: features; Distinction between General and Technical communication; Language as a tool of communication; Levels of communication: Interpersonal, Organizational, Mass communication; The flow of Communication: Downward, Upward, Lateral or Horizontal (Peer group); Barriers to Communication.

Unit 2: Constituents of Technical Written Communication: Word formation, Prefix and Suffix; Synonyms and Antonyms; Homophones; One Word Substitution; Technical Terms; Paragraph Development: Techniques and Methods -Inductive, Deductive, Spatial, Linear, Chronological etc; The Art of Condensation- various steps.

Unit 3: Forms of Technical Communication: Business Letters: Sales and Credit letters; Letter of Enquiry; Letter of Quotation, Order, Claim and Adjustment Letters; Memos, Notices, Circulars; Job application and Resumes. Reports: Types; Significance; Structure, Style & Writing of Reports. Technical Proposal; Parts; Types; Writing of Proposal; Significance.

Unit 4: Presentation Strategies: Defining Purpose; Audience & Locale; Organizing Contents; Preparing Outline; Audio-visual Aids; Nuances of Delivery; Body Language; Space; Setting Nuances of Voice Dynamics; Time- Dimension.

Unit 5: Value- Based Text Readings: Following essays form the suggested text book with emphasis on Mechanics of writing,
(i) The Language of Literature and Science by A.Huxley
(ii) Man and Nature by J.Bronowski
(iii) The Mother of the Sciences by A.J.Bahm
(iv) Humanistic and Scientific Approaches to Human Activity by Moody E. Prior
(v) The Effect of Scientific Temper on Man by Bertrand Russell.

Text Books and References:

1. Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, New Delhi.
2. Technical Communication – Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press 2007, New Delhi.
3. Effective Technical Communication by Barun K. Mitra, Oxford Univ. Press, 2006, New Delhi
4. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., New Delhi.
5. How to Build Better Vocabulary by M.Rosen Blum, Bloomsbury Pub. London.
6. Word Power Made Easy by Norman Lewis, W.R.Goyal Pub. & Distributors; Delhi.
7. Developing Communication Skills by Krishna Mohan, Meera Banerji- Macmillan India Ltd. Delhi.
8. Manual of Practical Communication by L.U.B. Pandey & R.P. Singh; A.I.T.B.S. Publications India Ltd.; Krishan Nagar, Delhi.

Course Code: ISC – S101T   **Breakup:**   3 – 0 – 0 – 3

Course Name: **Programming & Computing(C & UNIX)**

Course Details:

Basic concepts of Computers, Basic UNIX Concepts and Vi - Editor

Introduction to C: Basic Programming concepts, Program structure in C, Variables and Constants, Data types, Conditional statements, control statements, Functions, Arrays, Structures, Introduction to pointers, Introduction to File Systems.

Text Books and References:

1.   Programming in C, Schaum Series
2.   The 'C' Programming, Denis Ritchi (PHI)
3.   Programming in C, Venugopal (TMH)
4.   Let us C, Yashant Kanetkar (BPB)
5.   Programming in C, Balaguruswami (TMH)

Course Code: ISC – S101P   **Breakup:**   0 – 0 – 3 – 2

Course Name: **Computer Programming Lab:**

Course Details:

Learning OS Commands

Practice of all Internal and External DOS Commands, Writing simple batch programs, Exposure to Windows environment, Practice of UNIX commands and Vi editor, Writing simple shell script

C Programming:

Practicing programs to get exposure to basic data types, algebraic expressions, Conditional statements, Input Output Formatting, Control structures, arrays, functions, structures, pointers and basic file handling.

Course Code: **MTH-S102**   **Breakup:**   3 – 1 – 0 – 4

Course Name: Mathematics-II

Course Details:

Unit-I

Linear Algebra
Matrices, Elementary row and column operations, Echelon form, Rank of matrix, Determinants . Vector spaces, Linear dependence and Independence, Linear transforms and matrices, Consistency of linear system of equations and their solution, Special matrices : Symmetric, Hermtion etc, Characteristic equation, Cayley-Hamilton theorem(statement only), Eigen values and eigen vectors, Diagonalisation .

Unit-II

First order differential Equations : Seperable,Exact Differential Equation ,Integrating Factors, Linear differential equations with constant coefficients, Homogeneous linear differential equations, Bernouille Equation, Simultaneous linear differential equations, Differential equations of first order but not first degree, Claiurat's equation, Homogeneous linear differential equations of second order with constant coefficients, Complex root case, Differential operators, Euler-Cauchy equation Existence and uniqueness, Wronskain, Nonhomogeneous equations,
Solution by undetermined coefficients, solution by variation of parameters.
Series solution: Strum-Liouville problems , Ordinary differential equations of 2nd order with variable coefficients (Frobenius Method), Orthogonal polynomials, Bessel functions .

Unit-III: Laplace Transform

Laplace transform, Existence Theorem, Laplace transform of derivatives and integrals, Inverse Laplace transform, Unit step function, Dirac Delta function, Laplace transform of periodic functions, Convolution Theorem, Applications to solve simple linear and simultaneous differential equations.

Text Books and Reference :

1. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2005.
2. B.S. Grewal, Higher Engineering Mathematics, KhanPublishers,2005.
3. C. Ray Wylie & Louis C. Barrett, Advanced Engineering Mathematics, Tata Mc Graw-Hill Publishing Company Ltd. 2003.
 G.F. Simmons, Differential Equations, Tata Mc Graw-Hill Publishing Company Ltd. 1981.

Course Code: PHY-S102T　　　　　　　**Breakup: 3 – 1 – 0 – 3**

Course Name: Physics-II

Course Details:

Unit-I: Vector analysis: scalars, vectors, vector differentiation, gradient, divergence and curl, vector, integration, Gauss divergence and Stoke's theorem, co-ordinate systems (spherical polar & cylindrical), Electrostatics: electric fields, potentials, Gauss's law, electric dipoles and multipoles, polarization, bound charges, linear dielectrics and force on dielectrics, electric displacement, boundary condition of E and D, work and energy of electrostatics, Laplace's equation and uniqueness theorem, image theory.

Unit-II: Motion of charge in electric and magnetic field, Magnetostatics: current density, magnetic fields, Ampére's law, Faraday's law, magnetic potential, magnetic polarization, bound current, magnetic properties of materials (para, dia and ferro), boundary condition of B and H, basic idea of superconductor.

Unit-III: Displacement current, Maxwell's equations for free space and matter (dielectric and conductor), Electromagnetic waves, Poynting vector.

Unit-IV: Origin the refractive index, Interference: division of wave-front and division of amplitude; diffraction: Fraunhoffer, Grating, Resolving power (grating, prism, telescope and microscope); polarization: Phenomena of double refraction, Nicol prism, optical activity Production and analysis of plane, circular and elliptical polarized light, Frenels theory of optical activities and Polarimeters.

Unit-V: Fiber optics and photonics: Fundamental ideas about optical fiber, types of fibers, Total Internal Reflection (TIR), critical angle, acceptance angle and application, basic principal of Laser and Holography and fundamental ideas about photonics.

Text Books and References

1. Optics: Ajoy Ghatak
2. A textbook of OPTICS: Subrahmanyam, Brijlal and Avadhanulu
3. Electrodynamics: David J. Griffith
4. Classical electrodynamics: J. D. Jackson
5. Modern Physics: Author Beiser
6. Photonic Crystals: J. D. Joannopoulos, R. D. Meade, and R. D. Winn

Course Code: PHY-S102P   **Breakup:** 0 – 0 – 3 – 2

Course Name: Physics Lab-II

Course Details:

1. Newton's Ring (Ref. Book by K. K. Dey, B. N. Dutta)
<u>Apparatus Used</u> (Traveling Microscope, Support for Glass Plate inclined at 45^0 to the Vertical, Short Focus Convex Lens, Sodium Lamp, Plano Convex Lens, An Optically Plane Glass Plate)
2. Prism Spectrometer (Ref. Book by K. K. Dey, B. N. Dutta)
<u>Apparatus Used</u> (Spectrometer, Glass Prism, Reading Lens, Mercury Lamp)
3. Plane Transmission Grating (Ref. Book by K. K. Dey, B. N. Dutta)
<u>Apparatus Used</u> (Spectrometer, Diffraction Grating, Mercury Lamp)
4. Ballistic Galvanometer (Ref. Book by K. K. Dey, B. N. Dutta)
<u>Apparatus Used</u> (Ballistic Galvanometer, Morse key, Damping key, Condenser, Rheostat, Volt Meter, Storage Battery, Connection Wires)
5. Carey Foster's Bridge (Ref. Book by K. K. Dey, B. N. Dutta)
<u>Apparatus Used</u> (Carey Foster's Bridge, Laclanche cell, Resistance Box, Galvanometer, Plug Key, Copper Strip)
6. Fresnel's Biprism (Ref. Book by K. K. Dey, B. N. Dutta)
<u>Apparatus Used</u> (Sodium Lamp, Biprism, Convex Lens, Optical Bench with Four Uprights)
7. Variation of Magnetic Field (Ref. Book by K. K. Dey, B. N. Dutta)
<u>Apparatus Used</u> (Stewart and Gee type Tangent Galvanometer, Storage Battery, Commutator, Ammeter, Rheostat, One way Plug Key, Connection Wires)
8. Polarimeter (Ref. Book by K. K. Dey, B. N. Dutta)
<u>Apparatus Used</u> (Sodium Lamp, Polarimeter, Physical Balance)

Course Code: TCA-S101   **Breakup: 0 – 2 – 4 – 5**

Course Name: Engineering Drawing

Course Details:

Introduction- Drawing instruments and their uses, BIS conventions, lettering dimensioning and free hand practicing.

Orthographic projections: Lines, planes and surfaces of objects, Sectional views, Auxiliary views, Space geometry: lines and planes, True lengths and shapes, Properties of parallelism, Perpendicularity and intersections of lines and planes, Simple intersections of solids and development of lateral simple solids**.**

Isometric Projections: Introduction , isometric scale, isometric projection of simple plane figures, isometric projection of tetrahedron, hexahedron (cube), right regular prisms , pyramids, cylinders, cones, spheres, cut spheres and combinations of solids.

Introduction to computer graphics: Some problems on above topics on computer graphics.

Text Books and References:

1. Narayana,K.L. & Kannaiah,P. "Engg.Graphics". Tata McGraw Hill, New Delhi.
2. Bhatt,N.D. "Elementary Engg. Drawing" Charotar Book stall. Anand.
3. Lakshminarayanan ,V and Vaish Wannar , R. S. "Engg.Graphics".Jain Brothers , New Delhi.
4. Chandra, A.M. & Chandra Satish, "Engg.Graphics".Narosa.
5. French & Vireck, "The Fundamental Of Engg. Drawing & Graphic Tech.". McGraw Hill.
6. Gill, P.S. "A Text Book Of Machine Drawing" Katson Publishing House, Ludhiana.

Course Code: ESC-S201   **Breakup: 3 – 1 – 0 – 4**

Course Name: Engineering Mechanics

Course Details:

General Coplanar force systems : Basis concepts, Law of motions, principle of transmissibility of forces, Transfer of a force to parallel position, Resultant of a force system, simplest resultant of two dimensional concurrent & non concurrent force systems, free body diagrams, equilibrium & its equations, applications.

Trusses & Cables : Introductions, simple truss & solutions of simple truss, method of joints & method of sections.

Friction : Introductin , Laws of coulomb friction, equilibrium of bodies involving dry friction, belt friction, applications.

Centre of gravity , centroid, Moment of Inertia : Centroid of plane, curve, area ,volume & composite bodies, moment of inertia of plane area, parallel axis theorem, perpendicular axis theorem, principal moment inertia, mass moment of inertia of circular ring, disc, cylinder, sphere and cone about their axis of symmetry.

Beams: Introductions, shear force and bending moment , differential equations for equilibrium, shear force & bending moments diagrams for statically determinate beams.
Kinematics of rigid body: Introduction, plane motion of rigid bodies, velocity & acceleration under translation & rotational motion, Relative velocity, projectile motion.

Kinetics of rigid bodies: Introduction, force, mass & acceleration, work & energy, impulse & momentum, D'Alembert principles & dynamic equilibrium. Virtual work.

Text Books and Reference :
1. Beer F.P. & Johnston ,F.R. " Mechanics For Engineers", McGraw Hill.
2. Shames, I.H. " Engg. Mechanics" , P H I.
3. Meriam , J. L. " Statics" , J. Wiley.
4. Meriam , J. L. " Dynamics" , J. Wiley.

Course Code: ESC-S202   **Breakup: 3 – 1 – 0 – 4**

Course Name: Thermodynamics

Course Details:

Fundamental concepts: System , Property, Work and Heat interactions.
Zeroth law: Zeroth law of thermodynamics, Temperatutre & its measurement & scales.
First law: Thermodynamic processes, calculation of work in various processes, non flow work & flow work. Joule's experiment, First law of thermodynamics applied to open systems, study flow system and their analysis. Applications to closed systems and flow processes. Analysis of unsteady processes. Limitations of first law of thermodynamics, PMM1.Thermodynamics properties of fluids.
Second law: Devices coverting heat to work, Thermal reservoir, heat engines efficiency, Devices converting work to heat, heat pump, refrigerator, COP, Reversed heat engine, Kelvin planck statements, Clausius statement,reversible & irreversible processes, Carnot cycle ,PMM2, Entropy , Availability , equilibrium Criterion , Maxwell Relations Thermodynamics relations , Clapeyron equation , Gibb's Phase rule. **Properties of steam & thermodynamic cycles:** pure substance, properties of steam, Phase Diagram, Power & Refrigeration cycles ,Psychrometry. Adiabatic flame temperature , Equilibrium conversion, Statistical definition of entropy Kinetic theory of Ideal Gases.

Text Books and Reference :

1. Spalding D.B. & Cole E.H. " Engg. Thermodynamics" . Edward Arnold.
2. Hawkins, G.A. . " Engg. Thermodynamics" .Jhon Wiley & Sons.
3. Van Wylen, G.H. & Sonntag, R.E. "Fundamentals of Classical Thermodynamics". .Jhon Wiley & Sons.
4. Nag ,P.K. " Engg. Thermodynamics". Tata McGraw Hill.

Hollman ,J.P. " Thermodynamics". McGraw Hill

Course Code: MTH-S201   **Breakup: 3 – 1 – 0 – 4**

Course Name: Mathematics - III

Course Details:

Unit – I : Function of a Complex variable
Complex numbers- power and roots, limits, continuity and derivative of functions of complex variable, Analytic functions, Cauchy-Reimann equations, Harmonic function, Harmonic conjugate of analytic function and methods of finding it, Complex Exponential, Trigonometric, Hyperbolic and Logarithm function.

Unit – II : Complex Integration
Line integral in complex plane(definite and indefinite), Cauchy's Integral theorem, Cauchy's Integral formula, Derivatives of analytic functions, Cauchy's Inequality, Liouville's theorem, Morera's theorem, Power series representation of analytic function   and radius of convergence,Taylor's and Laurent's series, singularities, Residue theorem, Evaluation of real integrals, Improper Integrals of rational functions, Fourier integrals.

Unit – III : Fourier Series
Periodic functions, Trignometric series, Fourier series of period 2π , Eulers formulae, Functions having arbitrary period, Change of interval, Even and odd functions, Half range sine and cosine series, Complex fourier series, Fourier Integrals, Fourier Sine and Cosine Transform.

Unit – IV : Partial Differential Equations
Solution of first order partial differential equations-Linear and nonlinear(Charpit's method), Linear partial differential equations with constant coefficients of second order and their classifications - parabolic, elliptic and hyperbolic with illustrative examples. Methods of finding solutions using seperation of variables method. Wave and Heat equations upto two dimension

Unit – V : Probability and Statistics
Basics of probability, Bayes theorem, Random variables, Probability and density fuctions, Binomial, Poisson and Normal distributions.

Text Books and Reference :
1. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2005.
2. B.S. Grewal, Higher Engineering Mathematics, KhanPublishers, 2005.

Course Code: MEE-S201T   **Breakup: 2 – 0 – 0 – 3**

Course Name: Mechanical Design & Drawing

Course Details:

Review of engineering graphics, IS & ISO codes, Free hand sketching of Part Drawing & Dimensioning. Fits & Tolerances, Surface Finish , Design Of Simple machine elements;(Threaded fasteners, locking arrangements , Guides) of some assemblies. Design of joints; riveted ,welded & cotter. Design of keys. Shaft and Couplings Assembly drawing & part list . Computer aided drafting of machine components. Valves etc. A drawing Project on reverse engineering.

Text Books and Reference :
1. Lakshminarayanan ,v. & Mathur ,M.L. ,” A Text Book of Machine Drawing”. Jain Brothers, N. Delhi.
2. Siddheswar ,N. ,Kannaiah, P.& Sastry V.V.S. “ Machine Drawing” TMH,N.Delhi.
3. Bhandari, V.B. “Design of Machine Elements, TMH.N.Delhi.
4. Shigley & Mische,”Mechanical Engg. Design” McGraw Hill.

Course Code: MEE-S201T   **Breakup: 0 – 0 – 3 – 2**

Course Name: Mechanical Design & Drawing Lab

Course Details:

1 Drawing sheet (1 sheet)-Introduction:Scales, Type of lines, section line, dimensioning.
2 Drawing sheet-(1 sheet)-Orthographic projection in first & third angle of machine elements
3 Drawing sheet-(2 sheet)- Screwed fasteners
4 Drawing sheet-(1 sheet)- Keys & cotters and pin joints
5 Drawing sheet-(1 sheet)- Shaft couplings
6 Drawing sheet-(1 sheet)- Riveted joints
7 Drawing sheet-(3 sheet)- Assembly drawing

Text Books and Reference :
1. Lakshminarayanan ,v. & Mathur ,M.L. ,” A Text Book of Machine Drawing”. Jain Brothers, N. Delhi.
2. Siddheswar ,N. ,Kannaiah, P.& Sastry V.V.S. “ Machine Drawing” TMH,N.Delhi.
3. Bhandari, V.B. “Design of Machine Elements, TMH.N.Delhi.
4. Shigley & Mische,”Mechanical Engg. Design” McGraw Hill.

Course Code: MEE-S202   **Breakup:** 3 – 1 – 0 – 4

Course Name: Basic Solid Mechanics

Course Details:

Introduction: Stresses & strains, elastic constants,**Compound Stress & Strains:** Introduction, State of plane stress, principal stress and strain, Mohr's circle, Modelling of supports & equilibrium of forces / moments, Principles of mechanics , Axially loaded members & pressure vessels , Force analysis of slender members (BMD & SFD) . Stress at a point . Mohr circle , Strain at a point . 1-D material behaviour , Equationsm of elasticity, Torsion of shafts & tubes . Bending of beams with symmetric cross – section , Combined stresses, Yield criterion. Deflections in bending . Deflection of indeterminate systems by energy methods Concept of elastic instability. Thin cylinder & spheres, Thick Cyllinder, Helical & leaf spring, columns & struts.

Text Books and Reference :
1. Ramamurtham,S. "Strength of Materials" , Dhanpat Rai & Sons.
2. Popov, E.P., "Mechanics of Materials", PHI.
3. Andrew P. & SingerF.L., " Strength Of Materials",Happer & Row Publishers.
4. Ryder G.H. " Strength of Material".

Course Code: **HSS-S201**   **Breakup:**   **3 – 0 – 0 –4**

Course Name: **Industrial Management**

Course Details:

Introduction to Industrial management, Brief history of industries in India, Brief definition of management, organization and administration. Characteristics of management, Principle of management, Function of management like, planning, organization, direction, co-ordination etc.

Level of management, skills of management, inter relation between skills and levels of management, scientific management, Introduction to Schools of Management thoughts, introduction to organization, study of basic type of organization for ex. Line and staff organization, project organization, metrics organization, Informal organization, Introduction to industrial Psychology, Motivation theory and study of Maxlow, Need, Hierarchy Theory, Planned Location, Planned Layout. Study of different forms of layout like line layout, process layout, product layout, combinational layout, sixth position layout etc.

Objective of planned layout, introduction to material management, scope of material management, study of inventory control method, introduction to different types of inventory control techniques, introduction to work study, motion study etc, introduction to conflict management.

Text Book and References:

1. Khanna O.P. : Industrial Engineering
2. T.R. Banga : Industrial Engineering and Management
3. Mahajan : Industrial and Process Management

Course Code: **MEE-S203T**   **Breakup:**   **3 – 1 – 0 –3**

Course Name: **Kinematics and Mechanisms**

Course Details:

Introduction: Links-Types, Kinematic Pairs-Classification, constraints-types, Degree of freedom of planar mechanism. Inversions of four bar chain, slider crank chain and double slider crank chain. Mechanism Diagram & inversion. Mobility & Range of Movements. Displacement, Velocity & Acceleration analysis of planar linkages .Dimensional synthesis for motion ,Function & path generation. Dynamic force analysis, Cam profile Synthsis, flywheel, Inertia forces & Balancing for Rotating & Reciprocating Machines.

Text Book and References:
1. Ghosh ,A. & Mallik ,A.K. , "Theory of Mechanisms & Machines" EWP,ND.
2. Ambekar A.G. , "Mechanism & Machine Theory" Jain Brothers , N.D.
3. Rao ,J.S.& Dukkipati R.V. " Mechanism & Machine Theory" .Wiley Eastern Ltd. , India
4. Rattan , " Theory Of Machine" TMH,ND.

Course Code: **MEE-S203P**   **Breakup:**   **0 – 0 – 3 –2**

Course Name: **Kinematics and Mechanisms Lab**

Course Details:

1. Study of simple linkage models/mechanisms
2. Study of inversions of four bar linkage
3. Study of inversions of single/double slider crank mechanisms
4. Study of paucellier mechanism
5. Study of Hart Mechanism
6. Study of Grass-Hopper Mechaism
7. Study of Watt Mechanism
8. Study of Tchebicheff Mechanism

Course Code: **MEE-S204**   **Breakup:**   **3 – 1 – 0 –4**

Course Name: **Basic Fluid Mechanics and Rate Processes**

Course Details:

FLUID MECHANICS:
Fluid statics, Description of flows, Conservation of mass ; Stream function , momentum theorems , Navier – Stokes equation ,energy equation , Similitude & modelling. High Reapproximation, Boundary layers.

HEAT & MASS TRANSFER:
Rate law & Conservation law. Steady State & Unsteady conduction, Elementary convection . Simple ideas of mass transfer.

Text Book and References:
1. Agarwal , " Fluid Mechanics & Machinery" , TMH.
2. Som , S.K. & Biswas,G. " Introduction to Fluid Mechanics & Machins "TMH.
3. Bansal R.K. "A Text Book Of Fluid Mechanics & Hydraulic Machines" Laxmi Publications (p) Ltd. N.D.
   Rajput R.K. "A Text Book Of Hydraulics" , Sultan Chand & Sons , N.D.

Course Code: **MEE-S205T**   **Breakup:**   **3 – 0 – 0 –3**

Course Name: **Materials and Mechanical Metallurgy**

Course Details:

Structuring of crystelline solids , liquids and glass, imperfectionsin crystals , multiphase structures , phase change , mechanical behaviour , tensile properties , plastic properties , creep , fracture electric and magnetic properties , magnetic materials for applications , heat treatment process , effect of alloying elements on the properties of cabon steel , general properties, composition and uses of alloys of alluminium copper , nickel and bearing materials ., Chemical properties—Corrosion and oxidation , cutting tool and die materials , spring alloys , introduction to rubber , plastic , ceramic and refractory materials , Smart materials

Text Book and References:
Jain R K –Engineering materials
Van Vlac-Elements of material science , Addison-wesley publishing co mc
Raghvan V –Material science and engg , PHI
Agrawal B K – Introduction to engg materials-, TMH , ND

Course Code: **MEE-S205P**   **Breakup:**   **0 – 0 – 3 –2**

Course Name: **Materials and Mechanical Metallurgy Lab**

Course Details:

1. Strength testing of a given mild-steel specimen on UTM.
2. Impact testing on impact testing machine like Charpy, Izod.
3. Hardness testing of a given specimen using Rockwell & Vicker's/Brinell testing.
4. Fatigue testing on fatigue testing machine.
5. Creep testing on creep testing machine
6. Deflection of beam experiment
7. Torsion testing of a rod on torsion testing machine
8. To determine the compression test and determine the ultimate compressive strength for a specimen

Course Code: **MEE-S206**   **Breakup:**   **3 – 1 – 0 –4**

Course Name: **Advanced Solid Mechanics**

Course Details:

Equations of elasticity , uniqueness and superposition , Airy stress function approach , plain stress and plain strain problems , principle of virtual work energy , plate theory , torsion of non circular bars , membrane analysis , unsymmetrical bending , curved bars , thick cylinders , rotating discs , elastic stability , failure theories , introduction to strain gauges , photoelasticity.

Text Book and References:
   1. Boresi A P and Sidebottom O M –Advanced mechanics of materials , John willey and sons 1985
   2. Srinath L S –Advanced mechanics of materials , 1952
   3. Seeley F B and Smith J O –Advanced mechanicsof materials , 1952
   4. Richard G Budynas – Advanced strength and applied stress analysis , McGraw Hill, ND

Course Code: **CHM-S301**   **Breakup:**   **3 – 1 – 0 –4**

Course Name: **Chemistry - II**

Course Details:

UNIT-I - Chemistry of Materials:
Solid state- Classification, Band theory, Crystal lattice and unit cells, Coordination number, Crystal imperfections, Packing, Liquid crystals, Miller indices, Conducting properties of solids.
Phase Rule- Gibb's phase rule, one and two component systems, Eutactic system, Alloy system.
Electronic materials- Composites, Materials related to nanotechnology.

UNIT-II- Polymers:
Introduction, Classification, Structures of organic and inorganic polymers of industrial importance, Liquid crystalline and star polymers etc.

UNIT-III- Chemistry of cells:
Proteins, Nucleic acids, Enzymes, Lipids, Genome

UNIT-IV- Corrosion:
Introduction, Dry and wet corrosion, Atmospheric and Graphitic corrosion, Preventive methods

UNIT-V- Water Treatment:
Hardness of water, Softening of water, Reverse osmosis, Treatment
of boiler feed water by Calgon process, Ion-exchange resins and Zeolites.

UNIT-VI- Fuels:
Coal, Biomass, Biogas, Determination of net calorific values using Bomb calorimeter, Solar energy.

UNIT-VII- Environmental Pollution:
Types of pollution and pollutants, Air pollution, Formation and depletion of ozone, Smog and acid rain

UNIT-VIII- Clusters:
Introduction, Types of clusters- Vanderwaals clusters, Molecular clusters, Nanoclusters, Macroscopic clusters.

Text Book and References:
 Engineering Chemistry- Vol I & II by Kuriacose & Rajaram
Engineering Chemistry- 1. Dara
                            2. B.K. Sharma

Course Code: **MTH-S301**   **Breakup: 3 – 1 – 0 – 4**

Course Name: Discrete Mathematics

Course Details:

Unit-I
Logic: Introduction to formal logic, Formulae of prepositional logic, Truth tables, Tautology, Satisfiability, Contradiction, Normal and principle normal forms, Completeness. Theory of inference Predicate calculus: Quantifiers, Inference Theory of predicate logic, Validity, Consistency and Completeness.

Unit-II
Sets, Operations on sets, Ordered pairs, Functions and Sequences, Recursive definitions, Relations, Partially ordered sets, Equivalence relations, Composition of relations, Closures, Hasse Diagram's, Lattices (Definition and some properties).

Unit-III
 Algebraic structures : Definition, semi groups, Groups, Subgroups, Cyclic groups, Grop Homomorphism, Isomorphism, automorphism (Definitions) Properties of Homomorphism , Cosets, Lagrange's Theorem, Normal Subgroups. Rings, Fields
(Definitions only).

Unit-IV
Graph Theory: Incedence, Degrees, Walks, Paths, Circuits, Charectarization, Connectedness, Euler graphs, Hamiltonian graphs, Travelling salesman problem, Shortest distance algorithm (Djkstra's), Trees, Binary trees, Spanning trees, Spanning tree algorithms Kruksal's, Prim's .Planar graphs (Eulerformula, Kuratowski's two graphs) .

Unit-V
Introduction to combinatorics: Counting techniques, pigeon–hole principle, Mathematical induction, Strong induction , Permutations and Combination

Unit-VI
Generating functions, Recurrence relations and their solutions.

Text Books and Reference :
1. C.L.Liu : Discrete Mathematics
2. B.Kolman,R.C.Busby, and S.C.Ross, Discrete mathematical structures, 5/e, Prentice Hall, 2004
3. J.L.Mott, A.Kandel and T.P.Baker : Discrete mathematical structures For computer scientists & Mathematicians , Prentice–Hall India
4. J.P.Trembley, R. Manohar, Discrete mathematical structures with applications to computer science, McGraw –Hill, Inc. New York, NY, 1975

Course Code: **MEE-S301**   **Breakup: 3 – 0 – 0 – 4**

Course Name: Dynamics of Machine and Vibration

Course Details:

Governor, type and characteristics, Gears ,Synthesis of tooth profile , Gear trains , Gyrodynamics.
First and second order systems. Free and force vibration with and without damping, two degree of freedom systems, multi degree of freedom systems, calculation of natural frequencies by rayleigh , stodala, ,matrix , matrix iteration and holjder methods.Torsional vibration,vibration of continuous system, vibrating string , string, longitudnal vibration of rods , torsional vibration of rods ,Euler equation of beams.

Text Books and Reference:
Thomson W.T.,"Theory of vibration with applications " , CBS
TSE Morse and Hinkle,"Mechanical vibration",PHI
Schum Outlines Series "MechanicalVibration",Mc Graw Hill

Course Code: **MEE-S302**   **Breakup: 3 – 0 – 0 – 4**

Course Name: Advance Fluid Mechanics

Course Details:

Reynolds transports theorem, Integral and differential forms of mass balance equation, limit of incompressibility.
Stress tensor, stress at a point, momentum equation in terms of stress tensor, LaGrange and euler description of flow.
Construction of rate of strain tensor, Linearity between stress and rate of strain, stokes hypotheses , thermodynamics and hydrostatic pressure.
Navier stokes equation in Cartesian , cylindrical and spherical coordinates ,special form of navier stocks equations , Initial and boundary conditions.
Exact solution
Definition and examples
Boundary-Layer theory
Prandtl's boundary – layer theory, order of magnitude analysis, derivation of boundary layer equations, origin of separation and turbulence.
Flat plate problem
Momentum integral technique
Turbulance,equilibrium turbulance boundry layers,Prandtl's mixing length , Moody's diagram ,pipe network calculations

Text Books and Reference:
Fluid mechanics , White
Fluid mechanics , Streeter
Fluid Mechanics , Som and Biswas
Fluid mechanics , A.K.Mohanty

Course Code: **MEE-S303**   **Breakup: 3 – 0 – 0 – 4**

Course Name: I C Engine, Steam   & Nuclear Power

Course Details:

Classification of engines constructional details , scavenging , valve timing diagram , application of I C engines , actual cycles for SI & CI engines , volumetric efficiency , energy balance , combustion in SI & CI engines , carburetion and fuel injection , air and water cooling , refrigeration cooling , cooling system components , supercharging.
Steam power : Power cycles , boilers , air heaters , super heaters , combustion of jump and pulverized coal , boiler feed pump , draft system , water treatment , boiler for super thermal power stations , condensers and water heaters
Nuclear Power: Nuclear fission and nuclear fusion, PWR & BWR steam generators, loss of coolant, accident, safety devices
Text Books and Reference:
Ganeshan V – IC Engine, TMH; Colin F Obert- IC Engine, J Willey and sons
Echward F Obert – IC Engines, Interscience publishers; Sharma & Mathur – IC Engine
P K Nag – Power Plant Engineering

Course Code: MEE-S304   **Breakup: 0– 0 – 3 – 4**

Course Name: Lab I Appl. Mech., Fluid Mech., Vibration

Course Details:

(Minimum 12 experiments of the following)
1. Experiment on trusses
2. Statics experiment on equilibrium
3. Dynamics experiment on momentum conservation
4. Experiment on moment of inertia
5. Simple & compound gear train
6. Experiment on gears tooth profile, interference
7. Experiment on longitudinal vibration
8. Experiment on transverse vibration
9. Experiment on dead weight type governor
10. Experiment on critical speed of shaft
11. Experiment on gyroscope
12. Experiment on static/dynamic balancing
13. To verify the momentum equation using the experimental set-up on diffusion on submerged air jet.
14. To determine the co-efficient of discharge of an orifice of a given shape.
15. To calibrate an orifice meter, venturimeter, and bend meter and study the variation of the co-efficient of discharge with the Reynolds number.
16. To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number.
17. To study the velocity distribution in a pipe and also to compute the discharge by integrating the velocity profile.
18. To study the variation of friction factor ,'f' for turbulent flow in commercial pipes.
19. To study the boundary layer velocity profile over a flat plate and to determine the boundary layer thickness.

Course Code: **MEE-S305**   **Breakup:**   **3– 0 – 0 – 4**

Course Name: **Heat Transfer**

Course Details:

Introduction, Fourier's, Newton and Stefan Boltzman's law. Combined modes of heat transfer, thermal diffusivity, and overall heat transfer coefficient.
The thermal conductivity of solids,liquid and gases , factors influencing conductivity ,. The general differential equation of conduction,Convection,laminer boundry layer equations on a flat plate and in tube, dimenssional analysis of convection,empirical rrelationship for forced convection.Heat exchangers,

Text Books and Reference:
Fundamental of heat and mass transfer , New Age International Publishers
Heat transfer, Holman J.P., Tata Mc Graw Hill Company

Course Code: **MEE-S306**   **Breakup:**   **3– 0 – 0 – 4**

Course Name: **Production Process**

Course Details:
Manufacturing process and manufacturing system . Casting process , Design of gating system , risering and casting . Metal forming , Load estimation in forging , rolling , extrusion , punching , and drawing processess . Design Considerations in high velocity forming , welding , Bond formation . Temperature distribution and residual stresses . design consideration s in machining , Merchant's theory (2 D) , tool life and economics , Unconventional Machining process planning . automation , Jigs and fixtures.

Text Books and Reference:
Modern Machining process , Pandey P.C. & Shah H.S., TMH , New Delhi
Production Technology , Jain R.K. & Gupta S.C. , Khanna Publishing , New Delhi
A Text Book Of production Engineering , Sharma P.C. , S Chand & Company , New Delhi

Course Code: **MEE-S307**   **Breakup:**   **3– 0 – 0 – 4**

Course Name: **Design of Machine Elements**

Course Details:
Static strength criteria . Fracture mechanics , Rigidity – based design , stability , surface damage , S-N diagram , Goodman's Criteria . Material selection criteria , Design of clutch and brake , Design of Helical springs And Leaf spring . Design Of Spur , Helical < Bevel And Worm gear .Hydrdynamics lubrication and design of journal bearings , rolling element bearings , Design of belt and chain drives.
Text Books and Reference:
Design of Machine elements , Bhandari V.B. , TMH, New Delhi
A text book of machine design, Khurmi R.S. & Gupta J.K.
Design data book

Course Code: **MEE-S308**   **Breakup: 0– 0 – 3 – 4**

Course Name: **Lab 2, I.C. Engine, Heat Transfer & Automobile**

Course Details:

(Minimum 15 experiments of the following)

1. Performance analysis of Four stroke S.I. Engine
2. Determination of Indicated H.P. of I.C. Engine by Morse Test
3. Performance analysis of Four stroke C.I. Engines
4. Study & experiment on valve mechanism
5. Study & experiment on gear box
6. Study & experiment on differential gear mechanism of rear axle
7. Study & experiment on Steering mechanism
8. Study & experiment on Automobile Braking System
9. Study & experiment on Chassis and suspension system
10. Study & experiment on Ignition system of I.C. Engine
11. Study & experiment on Fuel supply system of S.I. Engine
12. Study & experiment on Fuel supply system of C.I. Engine
13. Experiment on Exhaust gas analysis of an I.C. Engine
14. Conduction: Composite wall experiment
15. Conduction: Composite cylinder experiment
16. Convection: Pool Boiling experiment
17. Convection: Experiment on heat transfer from tube-natural convection
18. Convection: Heat pipe experiment
19. Convection: Heat transfer through fin natural convection
20. Convection: Heat transfer through tube/fin-forced convection
21. Any experiment on Stefan's Law on radiation determination of emissivity etc.
22. Any experiment on solar collector etc.
23. Heat exchanger-Parallel flow experiment
24. Heat exchanger-counter flow experiment

Course Code: **SSM-302**   **Breakup: 0 –0 – 2 –2**

Course Name: **Seminar**

Course Details:

Emphasis on to develop the skill in presentation and group discussion. The subject may be selected from engineering/management.

Course Code: HSS – S301   **Breakup:**   **1 – 1 – 1 – 2**

Course Name: Professional Communication

Course Details:

Unit 1- Presentation Techniques

- Meaning and importance of presentation technique
- Use of presentation techniques in everyday life
- Presentation skills required for business organization
- Types of business presentations-meetings, seminars, Conferences

Unit 2-Oral presentations

- Effective oral presentation techniques
- Tips for good oral delivery; debates, elocution, impromptu speeches
- Levels and models of organizational Communication
- Interviews-types of interviews
- Group discussions

Unit 3- Written communication

- Style and tone of writing business messages and Documents.
- Writing for websites, internet e-mails and short messages
- Applications, letters, memos
- Proposals and report writing

Unit 4 - Nonverbal presentations

- Nonverbal communication techniques
- Business manners, ethics and personality development
- Audio/visual presentations, power point presentations
- Art of delivery

Unit 5- Literary concepts

- Stories, essays, comprehension
- Reading techniques-skimming and scanning methods
- Listening skills

Text Books and References:
1. "Business Communication Today", Bove'e, Thill and Schatzman: Pearson Education(Singapore),2003

2. "Business Communication-a framework of success", H.Dan O'Hair, James S.O'Rourke and Mary John O' Hair: South Western College Publishing 2001.

3. "Basic Business Communication", Raymond V.Lesikar, Marie E.Flatley: Tata McGraw Hill Publishing Company Ltd., 2002.

Course Code: HSS-S401   **Breakup:**   3 – 1 – 0 – 4

Course Name: **Industrial Economics**

Course Details:

Unit -I
Definition and scope of engineering economics
Concept of supply and demand
Price elasticity and cross elasticity of demand
Production
Engineering costs and cost estimation
Concept of time value of money
Cash flow analysis

Unit-II
Perfect competition
Monopoly
Monopolistic competition

Unit-III
National Income, GDP
Inflation, Deflation and treatment

Unit-IV
Functions of RBI
Indian Tax System

Text Books and References:

1. Henderson, M. James and Quandt, E. Richards, "Microeconomic Theory: A Mathematical Approach".
2. Koutsoyiannis, A., "Modern micro economics".ardwick, Philip., Khan Bahadure., Langmeed, John, "An Introduction to modern economics".
3. Samuelson, A. Paul, "Economics".
4. Shapiro, Edward. "Macro economics".
5. Newnan, G. Donald, Eschenbach, G.Ted, Lavelle, P. Jerome, "Engineering Economic Analysis".

Course Code: MEE-S401T   Breakup: 3 – 0 – 0 – 3

Course Name: Computer aided manufacturing

Course Details:

Fundamental concepts of numerical control. Direct numerical control (DNC) and computer numerical control (CNC) ,Adaptive control of manufacturing process, Manufacturing system concepts, Computer process monitoring and control, Offline use of computers, compuer process interface , programming introduction to FMS.
Laboratory component shall emphasize on computer numarical machines and FMS,robotics.

Text Books and References:

Radha Krishnan and Subramanyam S., CAD/CAM/CIM , Wiley eastern ltd., india
Koren Y. ,Benuri J., Numarical control of machinestools , Khanna publishers , ND
Kumar & Jha , Numarical control of machines
Roger S. Pressman , Numarical control and computer aided manufacturing
John WilleyAND SONS AND John williams
Childs JJ, Principles ofnumarical controls, Industrial press inc , NY

Course Code: MEE-S401P   Breakup: 0 – 0 – 3 – 2

Course Name: Computer aided manufacturing Lab

Course Details:

1. To study the characteristic features of CNC machine
2. Part programming(in word address format) experiment for turning operation(including operations such as grooving and threading) and running on CNC machine
3. Part programming(in word address format or ATP) experiment for drilling operation (point to point) and running on CNC
4. Part programming(in word address format or ATP) experiment for milling operation (contouring) and running on CNC
5. Experiments on Robot & programs
6. Experiment on transfer line/material handling
7. Experiment on difference between ordinary and NC machine, study or retrofitting
8. Experiment on study of system devices such as motors and feed back devices
9. Experiment on Mecatronics and controls

Course Code: MEE-S402T **Breakup:** 3 – 0 – 0 – 3

Course Name: **Refrigeration and air conditioning**

Course Details:

Introduction , carnot refrigeration cycle, COP, application

Air refrigeration cycle , Bell Coleman air refrigeration cycle , Brayton refrigeration cycle , optimum COP and pressure ratio , air craft refrigeration system , Classification of air craft refrigeration system , Actual power for refrigeration system, Dry air rated temperature(DART).

Refrigerants-Classification , nomanclature , desirable properties of refrigerants , common refigerants, secondery refrigerants & CFC free refigerants

Vapour compression system- Single stage system , analysis of vapour compression cycle , effect of pressure change on COP , Use of T-S & p-h charts , effect of subcooling of condensate on COP& capacity , effect of superheeting of vapour compression , construction details of refrigerator and air conditioners, Multy stage compression.

Vapour absorption system-Working Principles of continuous absorption system , comparision between absorption and compression system. Theory of mixtures , Temp. concentration diagram , Enthalpy concentration diagram. Adiabetic mixing of two systems , Lithium bromide water vapour absorption system. Working principles , Comparison with ammonia water system.

Air conditioning- Introduction to air conditioning , Psychromatrics , terms , definitions , adiabetic saturations& thermodynamics , wet bulb temperature , psychrometers , use of psychrometric charts , air conditioning requirements for comfort and industrial processes, comfort charts , comfort zones , cooling towers ,cooling and heating load calculations.

Refrigeration equipment & application—Expansion devices , duct design , food preservation cold storage , refrigerators , freezers , ice plants , water coolers , thermal analysis for human bodies, automotive air conditioning – brief overview. , Introduction to soler radiation distributions , emperical methods to evolute heat transfer throw walls & roofs, infiltration , passive heating and cooling of building.

Text Books and References:

1. Refrigeration and air conditioning by Manohar Prasad
2. Principles of refrigeration by Roy J Dosset
3. Refrigeration and air conditioning by Arora and Domkundwar
4. Refrigeration & air conditioning by C P Arora

Course Code: MEE-S402P   **Breakup:** 0 – 0 – 3 – 2

Course Name: Refrigeration and air conditioning Lab

Course Details:

1. Experiment on refrigeration test rig and calculation of various performance parameters.
2. To study different types of expansion devices used in refrigeration system.
3. To study different types of evaporators used in refrigeration system.
4. To study basic components of air-conditioning system.
5. Experiment on air conditioning test rig and calculation of various performance parameters.
6. To study air washers.
7. Study of window air conditioner.
8. Study & determination of volumetric efficiency of compression.
9. Experiment on ice-plant.
10. Experiment on two stage reciprocating compressors for determination of volumetric efficiency, p-v digram and effect of inter cooling.
11. Study of hermetically sealed compressors.
12. Experiment on desert coolers.

Course Code: MEE-S403   **Breakup:** 3 – 0 – 0 – 3

Course Name: Industrial management and production system

Course Details:

Concepts of management system and production system , Production planning and control , Work and time study , Resource allocation and linear programming , Plant lay out and material handling , Job decision & project management using PERT & CPM , Inspection and Quality control , forcasting and line balancing.

Text Books and References:

1. O.P.Khanna , Industrial engg. & management , Dhanpat Rai& sons.
2. L.S. Srinath , PERT &CPMPrinciples and applications , EWP
3. Everett E. Adam Jr., Ronald jobert , Production and operation management , PHI

Course Code: SST-S301   **Breakup:** 0 – 0 – 2 – 2

Course Name: Summer Training

Course Details:

6-8 Weeks practical training in a reputed industry/organisation is to be undertaken during summer after completing six semestersof study. The student will submit detailed report and givepresentation on training.

Course Code: **MEE- S404**   **Breakup: 3 – 0 – 0 – 4**

Course Name: **MEASUREMENT AND CONTROLS**

Course Details:

Similarity , errors , dynamic response , pitot tube , hot wire anemometer,Laser doppler velocimeter , optical tecniques for field measurement,image processing, volume averaged measurment ,uncertanity analysis signal processing and compensation for probev characteristics. Laplace transform , Inverse Laplace transform.Block diagrams, Transfer functions ,Signal flow graphs , state variable characterization of dynamic systems. Modeling of mechanical system elements, error sensing devices in control systems.stability,routh hurwitz criterion , Ny quist criterion.Root locus techniques , frequency domain analysis,Brief Introduction of Mecatronics.

Text Books and References:

Turbomachienry, Kadambi and prasad
Automatic control Engineering, Ogatta
Automatic control Engineering , Kuo
Mecatronics,HMT

Course Code: **MEE- S405**   **Breakup: 3 – 0 – 0 – 4**

Course Name: **Thermal Turbo machinery and compressible flow**

Course Details:

Classification, Velocity triangles, Euler formula and other expressions for energy and other expressions for energy transfer, utilization factor. Turbine efficiencies, reheat ,preheat and their effect on efficiency, Dimensional analysis, loss mechanisms, axial flow turbines, nozzles, Hydraulic turbines, Hydraulic pumps, compressors .Miscellaneous topics such as wind –mills, fluid couplings and torque converters, regenerative vortex and jet pumps.

Text Books and References:

Turbo Machinery :-S.M.Yalga
Gas turbine :- Ganesan
Gas turbine theory :- cohen &Rogers, Addision Wesley Longman Ltd.
Turbomachinery :- kadambi & Prasad

Course Code: **MEE- S406T**   **Breakup:**   **3 – 0 – 0 – 3**

Course Name: **COMPUTER AIDED DESIGN**

Course Details:

Introduction, Computer Graphics,Curve represantation,Interpolation vs approximation, Spline curve,Bezier curves and its properties,Brief mention of other curves.3-D Graphics,Solid modelling-sweep represantion wire mesh , constructive solid geometry and boolean operations, boundry represantion ,colors.

Computer aided design of machine elements such as shaft,springs,bearings and problem from other systems such as heat exchanger, inventory control etc. Writing computer programe in C ,Auto Cad and its uses.

Introduction to numerical method and optimization technique,curve fitti ng ,least square method. Newton – Raphson method forv root finding and for optimisation.Brief Introduction to numerical differtiation and integration.Linear programing for constrained optimisation (only graphical method)

Introduction to finite element method, one and two dimensional beam element (spring system) analysis.

TEXT BOOKS :-

Computer graphics by Hearn & Baker,Prentice Hall
CAD/CAM by groover
Let us C by Yashwant Kanetkar and also on C++
Computer Aided analysis & design of machine elements by Rao & Dukhipati
Numerical Methods using C by Xavier
Optimisation-SS Rao
FEM – SS Rao

Course Code: **MEE- S406P**   **Breakup:**   **0 – 0 – 3 – 2**

Course Name: **COMPUTER AIDED DESIGN LAB**

Course Details:

1. Line drawing or circle drawing experiment.
2. Geometric transformation algorithm experiment for translation.
3. Design of machine component or other system experiment.
4. Understanding and use of any 3-D Modelling Software commands.
5. Pro/E/Idea etc experiment.
6. Writing a small program for FEM for 2 spring system.
7. Root findings or curve fitting experiment.
8. Numerical differentiation or numerical integration experiment.

Elective Course

Course Code: MEE- S501   **Breakup:**   3 – 0 – 0 –4

Course Name: Robotics

Course Details:

Introduction-Robot Physical Configurations, End effectors sensor & actuators, Other technical features, Types and generations of robots, structures and operation of robot, robot applications for Material Transfer, Machine Loading, Welding, Spray Coating, Processing Operations, Assembly and inspection, basic robot motions, economics-Economics aspect of robots, Economics justification of robot, Economic justification methods, robot programming methods, VAL and AML with examples, Artificial intelligence & Its Application in Manufacturing.

Course Code: MEE- S502   **Breakup:**   3 – 0 – 0 –4

Course Name: Automobile Engineering

Course Details:

History of development , automobile engines , frame , transmission systems ,drive line and rear axle , wheel and tires, Steering system, suspension system , brakes, storage battery , Starter motor , Wiring for auto electrical systems.

Course Code: MEE- S503   **Breakup:**   3 – 0 – 0 –4

Course Name: Non Conventional Energy Sources

Course Details:

Indian and global energy sources , energy exploited , energy demand, energy planning , introduction to varios sources of energy. Bio-gas, Wind energy, solar energy ,Ocean energy , fuel cells, thermionic systems, Gas thermal energy.

Course Code: MEE- S504   **Breakup:**   3 – 0 – 0 –4

Course Name: Operation Research

Course Details:

Simlex algorithm, revisedvsimplex algorithm , duality theory , dual simplex algorithm , senestivity analysis , transportation and assignment problems ,network models ,principle of optimality and its applications , queueing systems, sequencing theory.

Course Code: **MEE- S505** **Breakup:** **3 – 0 – 0 –4**

Course Name: **Unconventional Manufacturing Process**

Course Details:

Introduction , Principle and working and application of unconventional machining process such as electro discharge machining , electro chemical machining , ultrasonic machining , abrasive jet machining etc.
Principle and working of unconventional welding process such as laser beam ,electron beam , ultrasonic, plasma arcwelding ,explosive welding under water welding, Unconventional forming process.

Course Code: **MEE- S506** **Breakup:** **3 – 0 – 0 –4**

Course Name: **Nuclear Power Engineering**

Course Details:

Introduction to control theory , point reactor kinetics with introduction to feedback effects. Non linear effects . Shielding . Introduction to reactor relibility and safety analysis . Radioactive waste disposal . Economics of nuclear power, Introduction to nuclear fuel cycles.

Course Code: **MEE- S507** **Breakup:** **3 – 0 – 0 –4**

Course Name: **Computer Simulation And Modelling**

Course Details:

Need for system modelling , systems approach to modelling , open and feed back system , combination of simple feedback systems,feed back time lag effect , feed back and managerial systems.Principle of analytical methods , measures of effectivnes , cost analysis.
Monte carlo simulation, generation of stochastic variates , continuous and discrete probability distributions , application of Monte carlo methods for production systems , computr simulation models , Marco dynamic model.

Course Code: MEE- S508 **Breakup:** 3 – 0 – 0 –4

Course Name: Metal Forming

Course Details:

Classification of forming processes, state of stress in forming processes,Review of plastic deformation theories. Influence of friction and lubrication in the metal working processes,Forging process , design considerations , material selection.,Elementry theory of rolling and important process parameter.Classification of extrusion process and influence of various process parameter.Analysis of drawing process and the influence of various process parameters,die design considerations.
Sheet metal working.

Course Code: MEE- S509 **Breakup:** 3 – 0 – 0 –4

Course Name: Machine Tool Design

Course Details:

Kinetics of machine tools, drive , controls , selective and preselections , operating devices , spindle and spindle bearing . Design of gear box , beds , columns , tables and guides.
Inspection and testing of machine tools , automation and programme control.

Course Code: MEE- S510 **Breakup:** 3 – 0 – 0 –4

Course Name: Pneumatic Control And Low Cost Automation

Course Details:

Introduction, Pneumatic control components , constructional details , filter , lubricator ,regulator , constructional features, types of cylinders,control valves for direction , pressure and flow – air hydraulic equipments,general approach to control system design,symbols and drawings , schematic layout,electro neumatic logic circuit , pneumatic counters,PLC based automation,Typical application circuits,sensors.

Course Code: **MEE- S511**   **Breakup:**   **3 – 0 – 0 –4**

Course Name: **Maintenance Management**

Course Details:

Introduction: cost of improper maintenance, characteristic, objectives and factors affecting maintenance.
 Benefits of right maintenance. Policies and responsibilities. System of maintenance.
Planned preventive maintenance: Planning, scheduling, monitoring and controlling, planning and control through, CPM/PERT. Repair cycle and complexity. Maintenance stages and schedule of complete overhauling. Lubrication and lubricating seal and packings, materials and standard spares stock rates. Organisation of maintenance department.
Restoration of machine parts: Transmission system, guides, bearings and housing: maintenance and repairs. Troubles in machine hydraulics.
Design of spare parts system, quality and cost control of maintenance. Manpower planning for maintenance, application of maintenance information system.

Course Code: **MEE- S512**   **Breakup:**   **3 – 0 – 0 –4**

Course Name: **Finite Element Methods**

Course Details:

Introduction,Calculus of variation,Ritz method,weighted residual methods.,Fundamental concepts of the FEM,discretization of the domain,one and two and three dimensional elements and interpolation functions,compatibility and completeness reqirements.Assembly and boundry conditions,formulation of FEM solutions.,application to simple boundry value problems,computer implementation.

Text Books and Refrences:

Introduction to Finite element analysis ,Martin and Carey Tata McGraw Hill
The finite element method for engg. Huebner,John willey.

Course Code: **MEE- S513**   **Breakup:**   **3 – 0 – 0 –4**

Course Name: **Composite Materials**

Course Details:

Structures and method of preparation of fibres and fiber reinforced composites. Micromechanics and prediction of elastic constants,strength of composites, properties of laminated composites and their constitutive equations, Laminates,Interfaial mechanics and properties, applications.

Course Code: **MEE- S514**   **Breakup:**   **3 – 0 – 0 –4**

Course Name: Fracture and Fatigue

Course Details:

Fracture : Energy release rate,crack tip stresses and deformation fields,plastic zone,elasto-plastic fracture,through J-integral and CTOD,Dynamic fracture,Testing for Fracture.Tooughness,Fatigue:Crack nucleation and growth, fatigue life prediction,Statistical analysis.

Course Code: MEE- S515   **Breakup:** 3 – 0 – 0 –4

Course Name: Optimization Method

Course Details:

Classical optimization methods,unconstraine mimimization, univarite, conjugate dirction, gradient and variable metric methods, constrained minimization , feasible direction and projections . Integer and geometric programing,genetic algorithms, simulated annealing techniques, design applications.

Course Code: MEE- S516   **Breakup:** 3 – 0 – 0 –4

Course Name: Computational Fluid Dynamics

Course Details:

Conservation laws , Weak solutions & shocks , Monotone difference schemes , Total variatiation diminishing schemes , Godunov-type schemes ,essentially nonoscillatory metods, flux limiters.