

**Course Name: MATHEMATICS I**

**Course Code: MA101 Credits : 4 LTP : 3 2 0**

**Pre Req :**

**Lecture wise breakup**

**No. of Lectures**

**1. FUNCTIONS OF ONE VARIABLE (13)**

Infinite series and convergence, Power series, Taylor's theorem, Approximation by polynomials, Curvature, Asymptotes, Curve tracing (Cartesian and Polar coordinates).

**2. FUNCTIONS OF SEVERAL VARIABLES (9)**

Limit, Continuity, Partial derivatives, Total derivative, Euler's theorem for homogeneous functions, Composite functions, Taylor's theorem, Errors and increments, Maxima and minima

**3. SOLID GEOMETRY (5)**

Cylinder, Cone, Quadric surfaces, Surfaces of revolution.

**4. DOUBLE AND TRIPLE INTEGRALS (6)**

Change of variables, Change of order of integration, Applications to area, volume and surface of revolution.

**5. DIFFERENTIATION OF VECTOR FUNCTIONS (5)**

Gradient, Divergence and Curl – their physical interpretation and representation in cylindrical and spherical coordinates.

**6. INTEGRATION OF VECTOR FUNCTIONS (7)**

Line, Surface and Volume integrals, Green's theorem in the plane, Stoke's theorem, Divergence theorem, Irrotational and Solenoidal Fields, Applications to Science and Engineering.

**TEXT BOOK**

1. Calculus and Analytic Geometry, Thomas and Finny, Pearson Education Asia,

**REFERENCE BOOKS**

1. Advanced Engineering Mathematics, Kreyszig, John Wiley and Sons.
2. Advanced Engineering Mathematics, Greenberg, Pearson Education Asia.
3. Advanced Engineering Mathematics, Wylie and Barrett, McGraw Hill
4. Calculus, James Stewart, Thomson

**Course Name : WORKSHOP PROJECT**

**Course Code : TAN 100**

**Credits : 2 (will be credited in 2<sup>nd</sup> / 3<sup>rd</sup> semester)**

**Pr-req. : ----**

The students shall be given individual / team project work during the summer / winter vacation involving the use of manufacturing skills learnt by them during the course work.

The project shall be of four weeks duration.

The grade earned by the students during the summer / winter training shall be entered in 2<sup>nd</sup> semester / 3<sup>rd</sup> semester for summer / winter training respectively.

**Course Name :** INTRODUCTION TO COMPUTING

**Course Code :** TAN 101

**Credits :** 5

**L T P :** 3 1 3

**Pr-req. :** ----

**Lecture wise breakup**

**No of Lectures**

***ALGORITHM DESIGN***

**(07)**

Concept of an algorithm, Algorithms to programs specification, Natural language, Flow-charts, Data Flow diagrams, Top-down development and stepwise refinement.

***DESIGN OF A PROGRAM***

**(04)**

Iterative versus recursive style, problem solving using procedural style and object oriented style Correctness and efficiency issues in programming. Use of a high level programming language for systematic, correct, efficient and maintainable development of programs

***ELEMENTS OF C PROGRAMMING***

**(25)**

Data types and operators, C programming constructs and control flow statements, Standard Library Functions Arrays, String handling and C string library, Program modularization, functions, Calls and definition of function. Recursive Techniques Pointers, Array of Pointers, Memory allocation, Structures, Unions, Enumerated data, Basic Searching and Sorting techniques, Elementary debugging tools and other IDE tools, Using preprocessor directive File handling, Stream and record I/O, Command line arguments.

***CONCEPTS OF OBJECT ORIENTED PROGRAMMING,***

**(06)**

Classes and objects, constructors, destructors Polymorphism and Inheritance

**BOOK:**

1. Ajay Mittal, "Programming in C- A practical approach", Pearson Education
2. Balaguruswamy, B. "Object Oriented Programming with C++" McGraw Hill Publication

**REFERENCES:**

1. Rajaraman V., "Fundamentals of Computers", PHI.
2. Sanders, D.H., "Computers Today", McGraw Hill.
3. Balaguruswamy B, "Programming in C" McGraw Hill Publication.
4. Byron Gottfried , "Programming with C", McGraw Hill
5. Kernighan & Ritchie, " The C Language Programming", Pearson

**Course Name :** ENGINEERING GRAPHICS

**Course Code :** TAN 102 **Credits :** 4 **L T P :** 2 0 4

**Pre Req:**

**Lecturer wise breakup**

**No. of lectures**

1. Introduction to Engineering Graphics. System of Projections. Technical lettering, scales, Orthographic Projections. 3 - views. Projection of oblique areas. Circular features. **(06)**

2. Reading of orthographic Views, Meaning of lines and areas. Pictorial sketching. Missing views and missing lines, Dimensioning, rules of dimensioning. **(06)**
3. General Introduction to isometric Projections. **(06)**
4. Projection of Points, Lines and Planes, Geometrical Constructions. Elements of descriptive geometry. True length, True shape, minimum distance, true angles.
5. Projection of Solids, Sectioning, intersection of Solids. **(06)**
6. Auxiliary, Planes and views. **(06)**
7. Development of Surfaces. **(06)**
8. Introduction to AutoCAD, Practice of Simple Drawings on AutoCAD **(06)**

**BOOKS:**

1. Engineering Drawing by P.S. Gill
2. Engineering Drawing by N.D. Bhatt
3. Engineering Graphics with Autocad by James D. Bethune, Pearson Education

**REFERENCES:**

- 1 Fundamentals of Engineering Drawing by Luzadder and Duff, PHI.

**Course Name :** INTRODUCTION TO ENGINEERING DESIGN  
**Course Code :** TAN 103 **Credits :** 4 **L T P :** 3 0 2  
**Pr-req. :** ----

<b>Lecture wise breakup</b>	<b>No. of Lectures</b>
<p><b>1. ENERGY CONVERSION PROCESSES</b> <span style="float: right;"><b>(10)</b></span>            Thermodynamic work, p-dv work in various processes, p-V representation of various thermodynamic processes and cycle, Properties of pure substance, Statements of I and II laws of thermodynamics and their applications in Mechanical Engineering. Carnot cycle for Heat engine, Refrigerator and Heat pump.            Statement and explanation of Fourier's law of heat conduction, Newton's law of cooling, Stefan Boltzmann's law, Conducting and insulating materials and their properties. Selection of heat sink and heat source.</p>	
<p><b>2. ENERGY CONVERSION DEVICES</b> <span style="float: right;"><b>(09)</b></span>            (Theoretical study using schematic diagrams only)            Package Boiler, Turbine Impulse &amp; Reaction turbine (Steam Gas Turbines). Working principle and applications of Reciprocating I.C. engines, Air motor, Reciprocating pumps (single acting &amp; double acting), reciprocating compressor, rotary compressors, fans, blowers, Study of household refrigerator, window air conditioner, split air conditioner Ratings and selection criteria of above devices. Refrigerants and their impact on environment.            POWER PLANTS (Description with Block Diagrams)            Thermal, Hydroelectric, Nuclear and Solar-Wind Hybrid Power Plants.</p>	
<p><b>3. FLUID MECHANICS</b> <span style="float: right;"><b>(08)</b></span>            Introduction to Fluids &amp; Flows: Fluid Properties; type of flow; stream line, path line, and streak line. Introduction to flow measurement Pitot tube, Venturimeter, Orifice</p>	

meter & Notches & Weirs (Rectangular & Triangular) Rotameter. Brief Introduction & classification of turbine & pumps.

**4. MATERIALS USED IN ENGINEERING AND THEIR APPLICATIONS (04)**

Metals – ferrous and Non-Ferrous, Nonmetallic materials, Material selection criteria.

**5. Design Principles (05)**

The design process; nature of design process; iteration and decision making / morphology, need identification and analysis; the specifications problem; divergence; convergence; detailing, testing, Standardisation and modularity, Design for manufacturing assembly, use, maintenance, safety, Reliability and robustness

**Term work shall consist of record of any seven experiments and creative design project as per the following:**

1. Study of water cooler, domestic refrigerator (conventional & frost free).
2. Study of window & split a.c.
3. Study of two stroke engine (petrol & diesel).
4. Study of four stroke engine (petrol & diesel).
5. Study of Cochran Boiler.
6. Flow measurement using. (a) Pitot tube  
(b) Venturimeter
7. Experimental verificational effect of insulating material on heat transfer.
8. Fabricating designed project using appropriate material to show creativity of design and implementing principles of design.

**BOOKS**

1. P.K. Nag, Thermodynamics, Tata McGraw – Hill publishing co. Ltd.
2. Hajra-Chaudhari, Workshop Technology.
3. Fluid Mechanics by D.S. Kumar.

**REFERENCE BOOKS**

1. Yunus A. Cengel and Boles, Thermodynamics, Tata McGraw – Hill Publishing Co. Ltd.
2. Arora and Domkunwar, Dhanpat Rai and Sons.
3. R.K. Rajput, Heat Transfer, S. Chand Publication, Delhi.
4. V.B. Bhandari, Design of Machine Elements, Tata McGraw-Hill Publishing Co. Ltd.

**Course Name: MECHATRONICS**

**COURSE NO: TAN 104**

**CREDIT: 5**

**LTP: 3 1 3**

**Pre Req:**

**Lecture wise break up**

**No of Lectures**

**1.INTRODUCTION TO MECHTRONICS**

Mechatronics Case Study, Introduction to Mechatronics Engineering Laboratory. (03)

**2.REVIEW OF BASIC ELECTRONICS**

Ohm's Law, Semi conductors (PN Junction Diode, AC Rectification, Zener Diode), Power Supplies (03)

### **3. PRINCIPLE AND APPLICATIONS OF TRANSISTORS AND OPERATIONAL AMPLIFIERS**

Transistor (Common Emitter Characteristics, Emitter Follower Circuit, FET), Thyristor, Triac Operational Amplifiers, (Inverting, Unity Gain, Non-inverting, current-to-voltage (C/V) and voltage-to-current (V/C) Amplifiers, Differential Amplifier, (Instrumentation Amplifier) (03)

### **4. DIGITAL ELECTRONICS**

Boolean Algebra, Digital Electronics Gates, Combinational Logic System (Simple Gates, NAND, NOR, Latches, Positive and Negative Logic, Tri-state Logic) Sequential Logic Systems (J-K flip-flop, registers and Counters, Timers and Pulse Circuits (06)

### **5. SENSORS AND TRANSDUCER PRINCIPLES AND APPLICATIONS**

Introduction to Sensors and Transducers; General Transducer Characteristics (Static and Dynamic performance Characteristics), Calibration, Signal Conditioning, Sensor and Transducer Applications, Measurement of : Angular Position, Linear Displacement, Rotational Speed, Force, Pressure, Strain, Flow Rate, Temperature (08)

### **6. DRIVE TECHNOLOGY : PRINCIPLE AND APPLICATION**

Physical Principle, Solenoid-type devices, DC Machines, A C Machines, Stepper Motors Drive Technology Applications

Linear Motors, Voice Coil Motors, Electro-pneumatic and Electro-hydraulic Actuators (06)

### **7. ELECTRO MECHANICAL SYSTEM PRINCIPLE AND APPLICATIONS**

Rotary to Linear Motion Conversion, Power Transmission, Electromechanical System Applications, Coupling, gearing, Belts, Pulleys, Bearings

### **8. A/D, D/A CONVERSION : BASIC PRINCIPLE (02)**

### **9. INTRODUCTION TO PLC**

PLC Hardware, plc Memory Structure, Basic Applications (05)

### **10 MICROPROCESSOR AND MICROCONTROLLER BASIC OPERATION AND APPLICATIONS (04)**

#### **TEXT BOOK:**

MECHATRONICS By W. Bolton ; Pearson Education

#### **REFERENCE BOOKS:**

1. Dan Neacsulescu Mechatronics published by Pearson Education (Singapore) Pvt. Ltd. Indian Branch, 482 FIE, Patparganj, Delhi India.
2. Book by H M T Limited, Mechatronic Tata McGraw Hill Publishing Company Ltd. New Delhi.
3. Mechatronic Principles, Concepts & Applications by Nitaigour P Mahalik published by TMH.

**Course Name :** INTRODUCTION TO MANUFACTURING

**Course Code :** TAN 105

**Credits :** 4

**L T P :** 2 0 4

**Pre-Req. :** ----

<b>Lecture wise breakup</b>	<b>No of Lectures</b>
<b>MANUFACTURING MATERIALS AND THEIR MANUFACTURING PROPERTIES</b>	<b>(03)</b>
Plastic Deformation of Materials, Cold Warm & Hot working of metals.	
<b>CONCEPT OF MANUFACTURING</b>	<b>(05)</b>
Examples of Manufacturing Products, Selecting Materials and Manufacturing Processes, Global Competitiveness and Manufacturing Costs	
<b>METAL CASTING PROCESSES &amp; EQUIPMENT</b>	<b>(05)</b>
Fundamental of Metal Casting, Principles of Various Metal Casting Processes and Their Applications	
<b>FORMING &amp; SHAPING PROCESSES AND EQUIPMENT</b>	<b>(04)</b>
Rolling, Forging, Extrusion & Drawing of Metals, Sheet Metal Working	
<b>MATERIAL REMOVAL PROCESSES AND MACHINES</b>	<b>(04)</b>
Fundamentals of Cutting, Cutting Tool Materials and Cutting Fluids, Machining Processes Used For Producing Round Shapes, Flat Surfaces and Other Shapes	
Abrasive Machining & Finishing Operations, Advanced Machining	
<b>JOINING PROCESS AND EQUIPMENT</b>	<b>(04)</b>
Weld-ability of Metals, Principles and Applications of Various Welding Processes. Brazing, Soldering, Adhesive Bonding	
<b>SURFACE TREATMENT</b>	<b>(03)</b>
Principles and Applications of various types of Surface Treatments	
<b><u>WORKSHOP EXERCISES</u></b>	
<b>CARPENTARY AND PATTERN MAKING</b>	<b>(06)</b>
Exercises including the use of important carpentry tools to practice various operations and making joints	
<b>FOUNDRY SHOP</b>	<b>(06)</b>
Preparation of small sand moulds and castings, firing a furnace	
<b>FORGING PRACTICE</b>	<b>(06)</b>
Simple smithy, forging exercises	
<b>MACHINE SHOP</b>	<b>(06)</b>
Exercise involving machining on a machine tool(s)	
<b>WELDING SHOP</b>	<b>(06)</b>
Exercises involving use of gas/ electric arc welding	
<b>ELECTRICAL AND ELECTRONICS SHOP</b>	<b>(06)</b>
Preparation of PCBs, Soldering applied to electrical and electronic applications	
<b>FITTING SHOP</b>	<b>(06)</b>
An exercise on fitting involving use if different fitting tools	
<b>SHEET METAL SHOP</b>	<b>(06)</b>
Exercise involving use of sheet metal forming operations for small jobs	
<b>ELECTROPLATING SHOP</b>	<b>(06)</b>
Exercise involving electroplating operations	

## **AUTOMOBILE SHOP**

**(06)**

Exercises involving use of automotive tools and automobile operations

### **TEXT BOOKS:**

1. Manufacturing Engineering. & Technology by Kalpakjian & Schmid – Pearson Education Asia 2002 Edition

### **REFERENCES:**

1. Materials & Processes in Manufacturing by Degarmo, Black & Kohser – Prentice Hall India
2. Manufacturing Technology by P. N. Rao - Tata McGraw Hill
3. Fundamentals of Metal Cutting & Machine Tools by Juneja & Sekhon – Wiley Eastern Ltd.

**COURSE NAME: ENVIRONMENTAL STUDIES**  
**COURSE CODE: TAN-106**  
**L T P: 4 0 0 CREDITS 4**

**Unit-1: The Multidisciplinary nature of Environmental Studies :** Definition, Scope and Importance ,  
Need for public awareness. (4)

**Unit- 2: Natural Resources : Renewable and Non-Renewable Resources :** Natural resources and associated problems ;Forest resources: Use and over-exploitation, deforestation, case studies, Timber extraction, mining, dams and their effects on forests and tribal people ; Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems; Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources , case studies; Food resources: World food problem, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies ; Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies; Land resources: Land as resource ,land degradation, man induced landslides, soil erosion and desertification; Role of an individual in conservation of natural resources ;Equitable use of resources for sustainable lifestyles. (8)

**Unit-3: Ecosystems :** Concept of an ecosystem ,Structure and friction of an ecosystem ,Producers , consumers and decomposers ,Energy flow in the ecosystem ,Ecological Succession ,Food chains, food webs and ecological pyramids ,Introduction , types , characteristic features, structure and function of the following ecosystem ;Forest ecosystem, Grassland ecosystem ,Desert ecosystem , Aquatic ecosystem (ponds, stream, lakes, rivers, oceans, estuaries) (8)

**Unit-4: Biodiversity and Its Conservation :** Introduction-Definition: Genetic, species and ecosystem diversity , Bio-geographical classification of India , Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic and option values ,Biodiversity at global, National and local levels, India as a mega-

diversity nation, Hot-spots of biodiversity, Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts, Conservation of biodiversity : In-situ Ex-situ conservation of biodiversity. (8)

**Unit -5: Environmental Pollution :** Definition, ,Causes, effects and control measures of ; Air pollution, Water pollution, Soil pollution, Marine Pollution, Noise Pollution , Thermal Pollution ,Nuclear Hazards; Solid waste Management: Causes, effects and control measures of urban and industrial wastes ;Role of an individual in prevention of pollution ,Pollution case studies ,Disaster management: floods, earthquake, cyclone and landslides. (8)

**Unit -6: Social Issues and the Environment :** From Unsustainable to Sustainable development ,Urban problems related to energy ,Water conservation, rain water harvesting , watershed management ,Resettlement and rehabilitation of people; its problems and concerns. Case Studies, Environmental ethics: Issues and possible solutions ,Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies, Wasteland reclamation, Consumerism and waste products, Environment Protection Act ,Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act , Issues involved in enforcement of environmental legislation, Public awareness. (8)

**Unit-7: Human Population and the Environment:** Population growth variation among nations, Population explosion- Family Welfare Programme , Environmental and human, health, Human Rights ,Value Education, HIV /AIDS, Women and Child Welfare, Role of Information Technology in Environment and human health ,Case Studies. (8)

**Unit-8: Field Work :** Visit to local area to document environmental assets- river/grassland/hill/mountain, Visit to a local polluted site-Urban/Rural/Industrial/Agricultural , Study of common plants, insects, birds ,Study of simple ecosystems- pond, river, hill slopes etc.(Field work Equal to 5 lecture hours) (8)

**Suggested Text books:**

1. Deswal S & Deswal A, Basic Course in Environmental Studies, Dhanpat Rai & Company Ltd., New Delhi.

**Selected References:-**

1. Agarwal, K C 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. De A.K. Environmental Chemistry, Wiley Eastern Ltd.
3. Heywood, V.H.& Watson, R.T.1995. Global Biodiversity Assessment Cambridge Univ. Press.
4. Odum, E.P.1971. Fundamentals of Ecology. W.B. Saunders Co. USA.
5. Rao M.N. & Datta, A.K.1987. Waste Water Treatment. Oxford & IBH Publ. Co. Pvt. Ltd.
6. Sharma B.K.,2001. Environmental Chemistry , Goel Publ. House, Meerut.

**Course Name :** UNIFIED MECHANICAL ENGINEERING  
**Course Code :** ENN 102 **Credits** : 4 **L T P** : 3 1 0

Pr-req. : ----  
Lecture wise breakup

No. of Lectures

1. **MECHANISM AND MACHINE: (05)**  
Definition and difference between mechanism & machine, links and its classification, kinematics pairs and its classification, degree of freedom of kinematics pairs, different type of motions, kinematics chain, simple and compound mechanism, kinematics chains, inversions of four bar and single slider crank chains, degree of freedom of planer mechanism, Grubler's criteria for degree of freedom, numerical problems.
2. **BELT DRIVE: (04)**  
Velocity ratio in belt drive, slip in belt drive and its effect on the velocity ratio, length of belt for open & crossed belt drive, limiting ratio of tensions for flat belt drive, modification in the limiting ratio of tensions for the V-belt (derivation not needed), angle of contact, power transmission by belt drive, centrifugal tension and stresses in belts, maximum tension in belt, effect of centrifugal tension on power transmission, condition for maximum power transmission, numerical problems.
3. **GEAR AND GEAR TRAIN: (03)**  
Concept of spur, helical and bevel gears, velocity ratio, train value, concept of module and pressure angle, simple, compound, reverted and epicyclic gear trains and their train value, concept of idler gear and its application, numerical problems.
4. **BALANCING: (04)**  
Introduction, balancing of rotating masses, static & dynamic balancing, balancing of single mass in one and multiple planes, balancing of several masses revolving in one plane and in different planes by analytical & graphical methods, numerical problems.
5. **FLYWHEEL & GOVERNOR: (04)**  
Introduction, turning moment diagram, fluctuation of crank speed, flywheel for punching presses, Watt and Porter governor, difference between flywheel & governor, numerical problems.
6. **CAM AND FOLLOWER (04)**  
Types of Cam and followers, terminology, uniform velocity, simple harmonic, motion, uniform acceleration and retardation and cycloidal motion of followers.
7. **GYROSCOPE (04)**  
Basic concept of Gyroscope, Gyroscopic couple, Stabilization of planes, ships, two wheeler and four wheeler.
8. **STRESS & STRAIN: (06)**  
Simple stress and strain, stress-strain diagrams for brittle and ductile materials, Poisson ratio and its applications, volumetric strain, relationship between the elastic constants, stress due to axial loading of the simple and compound bars connected in parallel and series modes, stresses due to thermal loading of the simple & compound bars connected in parallel and series modes, stresses in a bar due to its own weights, stresses in the variable cross-sectional bars due to axial loading, stress transformation of plane (2-D) stress system by analytical & graphical methods, numerical problems.

**9. SHEAR FORCE & BENDING MOMENT DIAGRAM: (03)**  
Shear force and bending moment in statically determinate beams under various type of loading, points of maximum bending moment and shear force in the beams.

**10. STRESSES IN BEAMS: (08)**  
Bending equation, stresses in beams due to Bending, Sectional modulus for rectangular, circular and T sections, Torsion equation, stress due to torsional loading, comparison of solid & hollow shafts under torsion loading, stresses due to combined bending & torsional loading, numerical problems.

**BOOKS:**

1. Theory of Machines: V. P. Singh, Dhanpat Rai & Co., Pvt. Ltd., Delhi.
2. Mechanics of Materials by FP Beer and R Johnson, Tata-McGraw Hill Publishers, India

**REFERENCES :**

1. Mechanics of Materials by E.J. Hearn.
2. Strength of Material: R K Rajput, S Chand
3. Mechanics of Material: Kripal Singh
4. Theory of Machines: S. S. Rattan, Tata McGraw Hill.

**Course Name: PHYSICS - I**

**Course Code: PY 101 Credits: 4 L T P: 3 1 0**

**Pre-requisite: None**

**Lecture-wise breakup (No. of Lectures)**

**1. OPTICS**

**Interference:** Division of wave front and amplitude; Fresnel's biprism, Newton's rings, Michelson interferometer and its applications for determination of  $\lambda$  and  $d\lambda$ . (4)

**Diffraction:** Fresnel and Fraunhofer diffraction, half period zones, zone plate, diffraction at a straight edge, plane transmission grating, dispersive power & resolving power of a grating. (5)

**Polarization:** Quarter wave and half wave plates, production and analysis of plane, circular and elliptically polarized light, optical activity and specific rotation, Biquartz and Laurent's half shade polarimeters. (4)

**Lasers:** Introduction to Lasers, pumping, population inversion, Einstein coefficients, three and four level lasers, Properties of Laser beams, Ruby, He-Ne, CO<sub>2</sub> and semiconductor lasers, Applications (5)

**Optical fibres:** Basic principles, fibre construction, light propagation in fibres, signal distortion, transmission losses, light wave communication and other applications. (4)

**2. SPECIAL THEORY OF RELATIVITY**

Inertial and non-inertial frames of reference, Galilean transformation, Michelson Morley Experiment, postulates of special theory of relativity, Lorentz transformation, Simultaneity, Length contraction, Time dilation, Doppler effect, Addition of velocities, variation of mass with velocity, mass-energy relation, four vectors, space-time continuum. (9)

### 3. EM THEORY

Gradient, Divergence and Curl – Physical meaning and mathematical expressions in Cartesian coordinate system, Divergence theorem & Stokes' theorem, Continuity equation, Review of basic concepts of electrodynamics before Maxwell, Maxwell's Modification of Ampere's law, Displacement-current, Maxwell's equations, Boundary conditions, Poynting's theorem & Poynting vector. (6)

EM wave equation and its simple plane wave solutions in non-conducting and conducting media, skin depth. (4)

#### **TEXT BOOKS:**

1. **Fundamentals of Physics** : Halliday, Resnick, Walker.
2. **Optics:** Optics, by Ajoy K Ghatak (Tata McGraw-Hill)
3. **EM Theory & Relativity:** Introduction to Electrodynamics, by D.J. Griffiths (Pearson)

#### **REFERENCE BOOKS:**

1. Fundamentals of Optics, by Jenkins & White (McGraw-Hill)
2. A Text Book of Engineering Physics, by Avadhanulu & Kshirsagar (S. Chand)
3. Lasers & Non-linear Optics, by B.B. Laud (New Age International)
4. Concepts of Modern Physics, by Arthur Beiser (McGraw-Hill)