M.Tech. (Material Science and Technology) – Scheme

(w.e.f. session: 2018-2019 onwards)

Semester - I

Paper code	Subject	Teaching Schedule			Marks Allocation			Credit
		L	P	Total	Minor Test	Major Test	Total	
MMST-101	Introduction to Materials	3	-	3	40	60	100	3
MMST-103	Characterization Techniques	3	-	3	40	60	100	3
*	Program Elective –I	3	-	3	40	60	100	3
MMST-113	Thermodynamics of Materials	3	-	3	40	60	100	3
MMST-115	Material Science and Technology Lab - I	-	8	8	40	60	100	4
MTRM-111	Research Methodology and IPR	2	-	2	40	60	100	2
**	Audit Course-I	2	-	2	100	-	100	0
	Total	*16*	*8*	*24*	*240*	*360*	*600*	*18*

Audit Course-I	
MTAD-101	English for Research Paper Writing
MTAD-103	Disaster Management
MTAD-105	Sanskrit for Technical Knowledge
MTAD-107	Value Education

Program Elective –I	
MMST-105	Ceramic and Composite Material Technology
MMST - 107	Ion Beams in Materials Processing
MMST - 109	Thin Film Technology and its Applications
MMST - 111	Flame Retardant Polymers

***Note1:** The course of program elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.

** **Note2:** Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

Semester - II

Paper code	Subject	Teaching Schedule			Marks Allocation			Credit
		L	P	Total	Minor Test	Major Test	Total	
MMST-102	Ion Beam Based Characterization Techniques	3	-	3	40	60	100	3
MMST-104	Statistical Methods for Data Analysis	3	-	3	40	60	100	3
MMST-106	Nanomaterials	3	-	3	40	60	100	3
MMST-108	Environmental Law & Materials	3	-	3	40	60	100	3
MMST-110	Material Science and Technology Lab – II	-	8	8	40	60	100	4
#MMST-112	Mini Project	-	4	4	40	60	100	2
*	Audit Course-II	2	-	2	100	-	100	0
	Total	*14*	*12*	*26*	*240*	*460*	*700*	*18*

*** Audit Course - II**	
MTAD-102	Constitution of India
MTAD-104	Pedagogy Studies
MTAD-106	Stress Management by Yoga
MTAD-108	Personality Development through Life Enlightenment Skills.

Note: 1.**#. Mini project:** During this course the student will be able to understand the contemporary/emerging technologies for various processes and systems. During the semester, the students are required to search/gather the material/information on a specific topic, comprehend it and present/discuss the same in the class. He/she will be acquainted to share knowledge effectively in oral (seminar) and written form (formulate documents) in the form of report. The student will be evaluated on the basis of viva/ seminar (40 marks) and report (60 marks).

2. * Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

3. Students be encouraged to go to Industrial Training/Internship for at least 6-8 weeks during the summer break with a specific objective for Dissertation Part–I (MMST-207). The industrial Training/Internship would be evaluated as the part of the Dissertation Part–I (with the marks distribution as 40 marks for Industrial Training/Internship and 60 marks for Dissertation work).

Semester - III

Paper code	Subject	Teaching Schedule			Marks Allocation			Credit
		L	D	Total	Minor Test	Major Test	Total	
*	Program Elective –II	3	-	3	40	60	100	3
**	Open Elective	3	-	3	40	60	100	3
MMST-207	Dissertation Part-I	-	20	20	40	60	100	10
	Total	*6*	*20*	*26*	*120*	*180*	*300*	*16*

*Program Elective –II**:** 1.Polymer Science and Technology (MMST - 201)
2. Intelligent Macromolecules (MMST - 203)
3. Green Chemistry (MMST -205)

**Open Elective	
MTOE-201	Business Analytics
MTOE-203	Industrial Safety
MTOE-205	Operations Research
MTOE-207	Cost Management of Engineering Projects
MTOE-209	Composite Materials
MTOE-211	Waste to Energy

Semester - IV

Paper code	Subject	Teaching Schedule			Marks Allocation			Credit
		L	D	Total	Minor Test	Major Test	Total	
MMST-202	Dissertation Part-II	-	32	32	100	200	300	16
	Total	*-*	*32*	*32*	*100*	*200*	*300*	*16*

Total credits of all four semesters – 68

Note 1: At the end of the second semester each student is required to do his/her Dissertation work in the identified area in consent of the Guide/Supervisor. Synopsis for the Dissertation Part-I is to be submitted within three weeks of the beginning of the Third Semester.

Note 2: Each admitted student is required to submit the report of his/her Dissertation Part-I as per the schedule mentioned in Academic calendar for the corresponding academic session otherwise the Dissertation Part-II cannot be continued at any level.

Note 3: Each admitted student is required to submit his/her final Dissertation Part-II as per the schedule mentioned in Academic calendar for the corresponding academic session only after the publication of two papers in a journal/International/National conference of repute like IEEE, Springer, Elsevier, ACM etc.

Note 4: The course of program/open elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.

Introduction to Materials

MMST - 101

L	*P*	*Major Test: 60 marks*
3	*0*	*Minor Test: 40 marks*
		Total: 100 marks
		Time: 3hrs

Unit - I

Introduction: Historical perspective of materials, Material science and technology, Classification of materials, Advanced materials, Materials of the future, Modern materials' needs.

Metallic Materials: Ferrous alloys: Steels, Cast irons; Non-ferrous alloys: Copper, Aluminum, Magnesium, Titanium and its alloys, refractory metals, super alloys, noble metals; Fabrication of metals: forming operations, casting, miscellaneous techniques; Thermal processing of metals: annealing processes, heat treatment of steels, precipitation hardening.

Unit - II

Crystalline Materials: Crystalline and non-crystalline materials; Fundamental concepts: lattice translational vector, symmetry operation, space lattice, basis, crystal structure, unit and primitive cell, two and three-dimensional lattice types; Metallic crystal structures: FCC, BCC, HCP and their unit cell characteristics; Some simple crystal structures: Sodium chloride, Cesium Chloride, Diamond and cubic Zinc sulfide; Crystallographic points, directions and planes.

Unit - III

Dielectric Materials: Introduction, Types of dielectric materials, Different types of polarizations, Local or internal field, Clausius - Mosotti equation, Dielectric loss, Dielectric breakdown, Ferroelectric materials, Dielectric properties, Frequency and temperature dependence of dielectric properties, Applications of dielectrics.

Superconducting Materials: Introduction, Types of superconductors, Properties and applications of superconducting materials.

Unit - IV

Magnetic Materials: Basic terminology, Classification of magnetic materials, Langevin theory of diamagnetism and paramagnetism, Weiss theory of paramagnetism and Ferromagnetism, Ferrimagnetic materials: structure and applications; Hard and Soft magnetic materials; Energy product of magnetic material, Magnetic recording materials, Magnetic principle of analog recording and reading, Magnetic bubble memory, Magnetic principle in computer data storage, Magnetic tape, Floppy disk, Magnetic hard disk, Computer aided tomography.

Biomaterials: Introduction, Classification of biomaterials, Applications.

References Books:

1. Material Science and Engineering: An Introduction, W.D. Callister, *Wiley- India Pvt. Ltd., New Delhi.*
2. Introduction to Solid State Physics, C. Kittel, *John Wiley & Sons (ASIA) Pte. Ltd. Singapore.*
3. Material Science and Engineering, V. Raghavan, *PHI Learning Private Limited, New Delhi*.
4. Material Science, V. Rajendran, A. Marikani, *Tata McGraw-Hill Publishing Company Limited, New Delhi*.
5. Engineering Materials: Properties and Applications of Metals and Alloys, C.P. Sharma, *Prentice-Hall of India Private Limited, New Delhi*.
6. Biomaterials: The intersection of Biology and Materials Science, J.S. Temenoff, A.G. Mikos, *Pearson, New Delhi*.

Characterization Techniques
MMST-103

L	*P*	*Major Test: 60 marks*
3	*0*	*Minor Test: 40 marks*
		Total: 100 marks
		Time: 3hrs

Unit - I

Hardness Testing Techniques: Introduction, Brinell hardness test: technique, precautions, advantages and applications, disadvantages; Vickers hardness test: process, derivation of Vickers formula, sources of errors, advantages and applications, disadvantages; Rockwell hardness test: introduction, dial reading, principle of operation, advantages, precautions; Superficial Rockwell hardness test: method, precautions; Microhardness test: method, precautions, applications; Comparison of Macrohardness and Microhardness tests.

Unit - II

Thermal Analysis Techniques: Introduction, Factors affecting thermal analysis results, Thermo-gravimetric Analysis (TGA) technique: components, kinetics of reactions, applications; Differential Thermal Analysis (DTA) and Differential Scanning Calorimetry (DSC) Techniques: components, applications; Simultaneous TG-DTA and TG-DSC: techniques and applications.

Unit - III

Microscopic Analysis Techniques: Light Microscopy: elementary geometrical optics, limits of resolution, different types of microscopy; Electron Microscopy: introduction, electron optics; Principle, instrumentation, methodology and applications of Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM) and Atomic Force Microscope (AFM).

Unit - IV

Spectroscopy Techniques: Infrared Spectroscopy: introduction, molecular vibrations, instrumentation, modes of operations, sampling techniques and applications; Ultraviolet and Visible Spectroscopy: introduction, colour and light absorption- the chromophore concept, theory of electronic spectroscopy, instrumentation and sampling, solvent effects and applications.

References Books

1. Mechanical Behaviour and Testing of Materials, A.K. Bhargava, C.P. Sharma, *PHI Learning Private Limited, New Delhi*.
2. Instrumental Methods of Analysis, H.W. Willard, L.L. Merritt, J.A. Dean, F.A. Settle, *CBS Publishers & Distributers*, *New Delhi*.
3. Thermal Methods of Analysis: Principles, Applications and Problems, P.J. Haines, Blackie Academic & Professional, London.
4. Biophysics, V. Pattabhi, N. Gautham, *Narosa Publishing House, Kolkata.*
5. Organic Spectroscopy, *W. Kamp, Replika Press Pvt. Ltd. India*.

Ceramic and Composite Materials Technology

MMST - 105

L	*P*	
3	*0*	*Major Test: 60 marks* *Minor Test: 40 marks* *Total: 100 marks* *Time: 3hrs*

Unit - I

Ceramic Materials: Introduction, Ceramic structure: basic crystal structures; Silicate ceramics: silica, silica glasses, silicates (simple, layered); Carbon: diamond, graphite, fullerenes, material of importance (carbon nanotubes); Imperfections in ceramics: brief introduction to atomic point defects, impurities in ceramics, diffusion in ionic materials; Mechanical properties of ceramics: brittle fracture (fractography of ceramics); Stress-strain behavior: flexural strength, elastic behavior; Mechanism of plastic deformation: crystalline and non-crystalline ceramics.

Unit - II

Applications and Processing of Ceramics: Type and applications of ceramics: glasses, glass-ceramics, clay products, refractories (fireclay refractory, silica refractory, basic refractory, special refractory), abrasives, cements, advanced ceramics (MEMS, optical fibres, ceramic ball bearings, piezoelectric ceramics); Fabrication and processing: glasses, glass-ceramics (glass properties, glass forming, annealing, glass tempering etc.), clay products (characteristics of clay, composition of clay products); Fabrication techniques: hydroplastic forming and slip casting, drying, firing, power pressing, tape casting.

Unit - III

Composites Structure and Processing: Introduction, Types of composites: particle reinforced (large particle composites, dispersion strengthened), fiber reinforced composites (fibre phase, matrix phase), polymer-matrix composites (GFRP, CFRP, aramid fibre-reinforced polymeric composite), metal-matrix composites, carbon-carbon composites, ceramic-matrix composites, cement-matrix composites (properties of each type of composite); Processing of fiber reinforced composites, Structural composite: laminar and sandwich panel composite.

Unit - IV

Application of composites: Composite material for various types of applications: thermal, electrical, electromagnetic, thermoelectric, dielectric, electromagnetic windows, optical (optical wave guides, LASER), magnetic, electrochemical, multiple functions, biomedical.

References Books:

1. Material Science and Engineering: An Introduction, W.D. William Callister, *John Wiley and Sons*, *New York*.
2. Chemical Synthesis of Advanced Ceramic Materials, D. Segal, *Cambridge University Press*, *New York*.
3. Composite Materials: Engineering and Science, F.L. Mathews, R. D. Rawlings, *Woodhad Publishing limited and CRC Press, USA*.

Ion Beams in Materials Processing

MMST - 107

L	*P*	*Major Test: 60 marks*
3	*0*	*Minor Test: 40 marks*
		Total: 100 marks
		Time: 3hrs

Unit - I

Ion-Solid Interactions: Fundamental principles, Binary elastic collisions, Ion stopping, Ion channeling, Ion induced target modification: ion implantation, ion mixing, ion sputtering.

Unit - II

Materials Processing-I: Introduction, Ion irradiation effects in crystalline materials: depth profiles and ion channeling, implantation-induced crystal damage, sputtering effects and implanted profile change, radiation damage annealing; Ion implantation into semiconductors: ion implantation into Silicon, ion implantation into Germanium, ion implantation into compound semiconductors.

Unit - III

Materials Processing-II: Ion beam synthesis of new phases in solids: introduction, buried insulating layers in silicon, ion beam-synthesized silicide layers, ion beam synthesis of nano-crystals in insulators; Ion beam mixing of interfaces, Ion beam slicing of thin layers, Ion beam shaping of Nanomaterials, Ion beam processing of other materials: ion implantation into metals, polymers and insulating optical materials.

Unit – IV

Ion Beam Preparation of Materials: Removal of target atoms by sputtering, Effect on sputtering yield: ion energy and ion atomic number, ion incident direction, selective sputtering due to ion channeling, target material, preferential sputtering; Preparation steps by ion beam irradiation: ion beam-induced cleaning and etching, ion beam-induced material deposition, ion beam-induced depth profiling, ion beam cutting, ion beam thinning.

References Books:

1. Ion Beams in Materials Processing and Analysis, B. Schmidt, K. Wetzig, *Springer Wien Heidelberg, New York*.
2. Ion Implantation and Synthesis of Materials, M. Nastasi, J.W. Mayer, *Springer Berlin Heidelberg, New York*.
3. Materials Science with Ion Beams, H. Bernas, *Springer-Verlag Berlin, Heidelberg, New York*.
4. Ion-Solid Interactions: Fundamentals and Applications, M. Nastasi, J.W. Mayer, J.K. Hirvonen, *Cambridge University Press*.

Thin Film Technology and its Applications

MMST - 109

L	*P*	
3	*0*	*Major Test: 60 marks* *Minor Test: 40 marks* *Total: 100 marks* *Time: 3hrs*

Unit - I

Thin Film Technology: Introduction, Thin film growth process: structural consequences of the growth process; Physical Vapor Deposition (PVD): introduction, vacuum evaporation, sputtering, PVD setup; Chemical Vapor Deposition (CVD), Chemical Solution Deposition (CSD), Electrochemical Deposition (ECD), Monitoring and analytical techniques: deposition rate and thickness measurement, structure analysis, composition analysis, Micro-fabrication techniques.

Unit - II

Thin Film in Optics: Optics of thin films, Antireflection (AR) coating, Multilayer and inhomogeneous AR coatings, Reflection coatings, Interference filters, Thin film polarizers, Beam Splitters, Integrated optics: waveguides, thin film optical components, passive devices; Active devices.

Unit - III

Quantum Engineering Applications: Introduction, Basic concepts, Superconductivity in thin films, S-N transition devices: switching devices, cryotron amplifiers, computer memory devices; Superconductive tunneling devices: quasiparticle tunneling, pair tunneling, SQUIDs, Applications of SQUIDs, Superconducting electronics.

Unit - IV

Surface Engineering Applications: Introduction, Surface passivation applications: coating of reaction product, metallic coatings, inorganic coatings, organic coatings; Tribological applications: wear-resistant coatings, lubricating coatings; Decorative applications, Miscellaneous applications: adhesion-promoting coatings, preparation of heterogeneous catalysts, preparation of nuclear fuels, fabrication of structure forms, biomedical applications.

References Books:

1. Thin Film Devices Applications, K.L. Chopra, I. Kaur, *Plenum Press, New York*.
2. Handbook of Thin Film Technology, Edited by L.I. Maissel, R. Glang, *McGraw-Hills Book Company, New York*.

Flame Retardant Polymers

MMST - 111

L	*P*	*Major Test: 60 marks*
3	*0*	*Minor Test: 40 marks*
		Total: 100 marks
		Time: 3hrs

Unit - I

Flame Retardant Polymers: Polymers: introduction, classification of polymers, polymer flames, flame retardation; Condensed-phase processes: bond dissociation, chemistry of polymer degradation, char forming polymers; Smoke: introduction, smoke measurement, effect of polymer structure on smoke formation, smoke suppressants for polymers.

Unit - II

Mechanisms and Modes of Action in Flame Retardancy of Polymers: Introduction, General considerations, Gas-phase mechanisms, Condensed-phase mechanism, Modes of action of halogen, phosphorus, borates, metal hydroxides and other hydrated inorganic additives-based flame retardants.

Unit - III

Flame Retardant Polymer Composites: Introduction, Properties of the constituents of composites, Flammability of composite structures, Methods of imparting flame retardancy to composites.

Flame Retardant Polymer Nanocomposites: Introduction, Structure and properties of layered silicates, Structure of Nanocomposites, Synthesis methods, Flame-retardant properties of Nanocomposites, Mechanism of flame retardancy in Nanocomposites.

Unit - IV

Recent Developments in Flame-retarding Thermoplastics and Thermosets: Introduction, Factors affecting flammability and its reduction, Testing procedures and hazard assessments: general aspects, Flame-retardant thermoplastics: Polyolefins, Polystyrenes, Acrylics, PVC, Saturated polyesters, Polyamides, Polycarbonate and Poly(phenylene oxide); Flame-retardant elastomers, Flame-retardant Thermosets, Inherently flame-retardant polymers.

References Books:

1. Fire Retardant Materials, Edited by A.R. Horrocks, D. Price, CRC Press, *Woodhead Publishing Limited, Cambridge, England*.
2. Handbook of Building Materials for Fire Protection, Edited by C.A. Harper, *McGraw-Hill, New York*.
3. Fire Retardancy of Polymers: New Applications of Mineral Fillers, Edited by M.L. Bras, C.A. Wilkie, S. Bourbigot, *Published by the Royal Society of Chemistry, Cambridge, UK*.
4. Flame - Retardant Polymeric Materials, Edited by M. Lewin, S.M. Atlas, E.M. Pearce, *Plenum Press, New York*.
5. Polymer Science and Technology, R.O. Ebewele, *CRC Press, New York*.
6. Plastics Technology Handbook, M. Chanda, S.K. Roy, *CRC Press, Taylor & Francis Group, New York.*
7. Fire Retardancy of Polymeric Materials, Edited by C.A. Wilkie, A.B. Morgan, *CRC Press, Taylor & Francis Group, New York*.
8. Flame Retardant Polymer Nanocomposites, Edited by A.B. Morgan, C.A. Wilkie, *Wiley-Interscience, A John Wiley & Sons, New Jersey*.

Thermodynamics of Materials

MMST-113

L	*P*	*Major Test: 60 marks*
3	*0*	*Minor Test: 40 marks*
		Total: 100 marks
		Time: 3hrs

Unit - I

Basic Concepts of Classical Thermodynamics: Methodology and scope of thermodynamics, Thermodynamics system, State and phase, Equilibrium and non-equilibrium systems, Reversible, Irreversible and Quasistatic processes, State parameters and functions, The zeroth and first laws of thermodynamics and their consequences.

Thermodynamics Potentials: Definitions, Physical meaning and transformations of thermodynamics potentials, Maxwell relations and transformations of thermodynamic parameters, Chemical potential as natural variable.

Laws and Equations of Thermodynamics: The second law of thermodynamics, The third law of thermodynamics, Extremum principles in equilibrium thermodynamics, Equations of state.

Unit - II

Entropy: Entropy as state functions, Entropy differentials, Entropy as a measure of energy quality, Balance of entropy in isolated, closed and open systems, Micro- and macro-states molecular interpretation of entropy and increase of disorder.

Chosen Elements of Statistical Thermodynamics: Distribution function, Boltzmann probability distribution, Canonical Ensemble, Entropy of mixing.

Chosen Applications of Classical Thermodynamics: Ideal and real gases, Thermo- dynamical quantities for pure liquids and solids, Many component solutions: ideal, non-ideal, dilute, regular; Thermodynamics functions of mixing.

Unit - III

Thermodynamics of Chemical Transformations: Energy conservation in chemical reactions, Thermal effects of chemical reactions, Hess law, Kirchoff law, Chemical reaction rate, Chemical equilibrium and the law of mass action, Entropy production in chemical reaction, Coupled reactions, Le Chatelier-Braun principle.

Stationary States: Entropy production in the stationary state, Stability of stationary state, Stationary state with chemical reactions, Coupling of stationary states.

Unit - IV

Thermodynamics of Phase Changes: Phase equilibrium and the Gibbs phase rules, Phase diagram, Phase transitions: thermodynamics, classification and free energy at the phase transition, Gibb theory of crystallisation, Crystallisation rate, Avrami equation.

Fundamentals of Non-equilibrium Thermodynamics: Characteristic of the non-equilibrium systems, Entropy production in irreversible processes.

Local Equilibrium and Local Formulation of the Second Law: Maximum and minimum of entropy production, Minimisation of energy dissipation, Negentropy.

References Books

1. Introduction to Modern Thermodynamics, D. Kondepudi, *John Wiley & Sons, New York*.
2. Modern Thermodynamics: From Heat Engine to Dissipative Structures, D. Kondepudi, Ilya Prigogine, *John Wiley & Sons, New York*.
3. Thermodynamics of Materials: Tom 1, D.V. Ragone, *John Wiley & Sons, New York*.
4. Thermodynamics of Materials: Tom 2, D.V. Ragone, *John Wiley & Sons, New York*.
5. Introduction to the Thermodynamics of Materials, D.R. Gaskell, *Taylor & Francis, New York.*
6. Physical Ceramics: Principles for Ceramic Science and Engineering, Y. Ming, D.P. Birnie, W.D. Kingery, *John Wiley & Sons, New York*.

Material Science and Technology Lab- I

MMST-115

L	*P*	
0	*8*	*Major Test: 60 marks* *Minor Test: 40 marks* *Total : 100 marks* *Time : 3hrs*

1. To characterize the thermo-gram and differential thermo-grams of some compounds.
2. To determine the molecular weight of polystyrene sample using viscometric method.
3. To prepare phenol-formaldehyde resin (Resole) and then convert it into phenolic laminate.
4. To prepare Hexamethylene –diamine and Adipic acid (Nylon 66) polymer.
5. To determine the amount of sodium and potassium in different water samples by flame photometer.
6. To find the band gap of semiconductor using four probe method.
7. To study the hysteresis loss by tracing a BH curve.
8. To study the hardness of materials by Brinell hardness testing machine.
9. To study the hardness of materials by Rockwell hardness testing machine.
10. To study the hardness of materials by Vicker hardness testing machine.

Note: At least eight experiments should be performed by the students. The experiments may be included or excluded depending upon lab facility.

MTRM-111	Research Methodology and IPR						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**2**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	*To enable students to Research Methodology and IPR for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.*						
Course Outcomes (CO)							
CO1	Understand research problem formulation.						
CO2	Analyze research related information						
CO3	Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.						
CO4	Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.						

Unit 1

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit 2

Effective literature studies approaches, analysis, Plagiarism, Research ethics, Effective technical writing, how to write report, Paper.Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

Unit 3

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 4

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'.
2. C.R. Kothari, "Research Methodology: Methods & Techniques, 2nd edition or above, New Age Publishers.
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2 nd Edition , "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov , "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.

Ion Beam Based Characterization Techniques

MMST-102

L	*P*	*Major Test: 60 marks*
3	*0*	*Minor Test: 40 marks*
		Total:100 marks
		Time: 3hrs

Unit - I

Rutherford Backscattering Spectroscopy: Introduction, Scattering fundamentals: kinematic factor, stopping cross-section, Rutherford scattering cross-section; Principle of Rutherford Backscattering Spectroscopy, Fundamental of RBS techniques and its characteristics, Deviations from Rutherford formula, Instrumentation/Experimental, RBS spectra from thin and thick layer, Spectrum Analysis/Simulation, Applications and limitations of RBS.

Unit - II

Elastic Recoil Detection Technique: Introduction, Fundamentals of the ERDA technique, Principle and characteristics of ERDA, ERDA using E-detection, ERDA with particle identification and depth resolution: ERD using transmission telescope, position-sensitive detector, Time-of-flight spectrometry; Heavy ion ERDA, Data analysis, Advantages and limitations of ERDA.

Unit - III

Accelerator Mass Spectrometry (AMS): Introduction, Principle, Experimental, AMS using low-energy accelerators, Sample preparation for AMS, Time-of-Flight Spectrometry (TOF-MS), Detection limits of particle analyzed by AMS, Applications of AMS, Advantages and limitations of AMS.

Unit - IV

XRF and PIXE Techniques: Introduction, Principle of XRF and PIXE techniques, Theory and concept, Instrumentation/Experimentation: modes of excitation for XRF analysis, x-ray detection and analysis in XRF, Source of excitation and x-ray detection in PIXE analysis: ion sources, choice of beam/PIXE using heavy ion beams, Qualitative and Quantitative analysis, Sources of background, Applications of XRF and PIXE techniques.

References Books

1. Atomic and Nuclear Analytical Methods, H.R. Verma, *Springer Berlin Heidelberg, New York*.
2. Fundamentals of Surface and Thin Film Analysis, L.C. Feldman, J.W. Mayer, *North Holland, New York*.

Statistical Methods for Data Analysis
MMST-104

L	*P*	*Major Test: 60 marks*
3	*0*	*Minor Test: 40 marks*
		Total: 100 marks
		Time: 3hrs

Unit - I

Statistical Methods: Introduction, Functions and Importance.

Measures of Central Tendency: Measure of average value: introduction, objectives, requisites of good average and types; Simple Arithmetic Mean: method- individual observations, discrete series, continuous series, open-end classes, properties, merits and demerits; Weighted Arithmetic Mean, Median: method-individual observations, discrete series, continuous series, property, merits and demerits, usefulness; Mode: method-individual observations, discrete series, continuous series, merits, demerits and usefulness; Relation between Mean, Median and Mode, Geometric Mean: properties, methods-individual observations, discrete series, continuous series, uses, merits and demerits; Harmonic mean: methods, usefulness, merits and demerits; Relationship between AM, GM and HM.

Unit - II

Measures of Dispersion: Introduction, Significance, Properties and methods, Range: method, merits, demerits and uses; The Interquartile Range or the Quartile deviation: method, merits, demerits; Mean Deviation: method in discrete and continuous series, merits, demerits and usefulness; The Standard Deviation: method in discrete and continuous series, properties, coefficient of variation, variance, merits and demerits.

Skewness and Kurtosis: Skewness: introduction, tests, methods, moments, moments about arbitrary origin, Sheppard's correction for grouping errors, measure of Skewness based on moments; Measures of Kurtosis.

Unit - III

Theoretical Distribution: Introduction, Binomial Distribution: introduction, properties, constants, standard deviation, importance, fitting; Poisson Distribution: introduction, constants, role, fitting; Normal Distribution: introduction, graph, importance, properties, condition for normality, area under the curve, significance, methods of fitting- ordinates and areas.

Unit - IV

Propagation of Errors: Standard error of a sum, difference, product and compound quantity.

Empirical Laws and Curve fitting: Introduction, Graphical method, Law Reducible to Linear Law, Principle of least squares, Working procedure to fit the straight line, parabola and other curves; χ^2 test and goodness of fit.

References Books

1. Statistical Methods, S.P. Gupta, *Sultan Chand & Sons Educational Publishers, New Delhi*.
2. Theory of Error, J. Topping, *Unwin Brothers Limited, London*.
3. Higher Engineering Mathematics, B.S. Garewal, *Khanna Publications, New Delhi*.
4. An Introduction to Probability: Theory and its Applications, Vol.-I, W. Feller, *Wiley India*.

Nanomaterials
MMST-106

L	*P*	*Major Test: 60 marks*
3	*0*	*Minor Test: 40 marks*
		Total: 100 marks
		Time: 3hrs

Unit - I

Material Science at Nanoscale: Introduction, Lesson from nature, Nanoworld is uniquely different, Classification of nanomaterials, Applications in various fields.

Nanoparticle Synthesis: Introduction, Classification of nanoparticles synthesis techniques, Solid-state synthesis of nanoparticles, Vapor phase synthesis of nanoparticles: inert gas condensation, plasma based, flame based, spray pyrolysis; Solution processing of nanoparticles: sol-gel, solution precipitation, water-oil microemulsion.

Unit - II

Carbon Nanotubes: Introduction, Structure of carbon nanotubes : single-wall, multiwall; Synthesis of carbon nanotubes, Solid carbon source-based production techniques: laser ablation, electric arc, three phase ac arc plasma; Gaseous carbon source-based production techniques: heterogeneous process, homogeneous process; Synthesis of carbon nanotubes with controlled orientation, Growth mechanism of carbon nanotubes: catalyst-free growth, catalytically activated growth, low and high temperature conditions; Properties of carbon nanotubes, Applications of carbon nanotubes.

Unit - III

Metal Oxide Nanoparticles: Introduction, Synthesis Methods: Hot-injection, Heating-up, Solvothermal, Seed-Mediated growth, Self-Assembled nanoparticles; Organic-Inorganic Hybrid Materials: introduction, rare earth oxide based hybrid nanoparticles, tungsten oxide based hybrid materials, hybrid materials synthesized in other solvents; Properties and Applications.

Unit - IV

Polymer Nanocomposites: Introduction, Polymer matrices, Synthesis methods, Solution intercalation, Melt intercalation, Roll milling, In-situ polymerization, Emulsion polymerization, High shear mixing, Properties of polymer nanocomposites, Applications of polymer nanocomposites,

References Books

1. Nanomaterials Handbook, edited by Y. Gogotsi, *Taylor & Francis Group, New York*.
2. Springer Handbook of Nano-technology, edited by B. Bhushan, *Springer*.
3. Carbon Nanotubes: Properties and Applications, edited by M.J. O'Connell, *Taylor & Francis Group, New York*
4. Metal Oxide Nanoparticles in Organic Solvents: Synthesis, Formation, Assembly and Applications, M. Niederberger, N.Pinna, *Springer*, *New York*.
5. Polymer Nanocomposites: Processing, Characterization and Applications, J.H. Koo, *McGraw Hill, New York*.
6. Principles of Polymer Science, P. Bahadur, N.V. Sastry, *Narosa Publishing House, New Delhi.*
7. Nanotechnology: Basic Science and Emerging Technologies, M. Wilson, M. Simmons, B. Raguse, *Overseas Press, New Delhi*.
8. Nano Science and Technology, Edited by R.W. Kelsall, I.W. Hamley, M. Geoghegan, *John Wiley & Sons Ltd, India*.

Environmental Law & Materials
MMST-108

L	*P*	*Major Test: 60 marks*
3	*0*	*Minor Test: 40 marks*
		Total:100 marks
		Time: 3hrs

Unit-I

Environmental Law: Environmental protection under constitution, Fundamental duty of citizens to protect environment; Environmental protection as principle of State Policy; Environment and fundamental rights, The U.N. conference on Human Environmental, Stockholm, 1972.

Unit - II

Environmental Materials: Introduction, Approaches/Methods of considering environmental impact of a material or product: life cycle analysis.

Raw Material Extraction: Introduction, Extraction of Aluminum and Iron, Environmental impact of extraction metallurgy, Energy consumption in extraction of material and in recycling of a product: in case of Aluminum and Steel.

Unit - III

Design of Materials: Proper material selection, Process selection and product design for successful recycling, Waste minimization, Energy efficiency and increased lifetime.

Impact of Processing of Materials: Environmental problems associated with processing of metals, polymers, ceramics, composites, food and methods to overcome these problems.

Unit - IV

Sustainable Materials: Introduction, Uses of sustainable materials generally plant- based materials: wood, natural fiber composites, natural polymers; Recycled materials like polymers, composites, aluminium and steel.

Materials for Green Energy: Need of renewable energy, Brief description of bio-fuel, biomass, hydroelectricity, geothermal, solar energy, tidal power, wind power, wave power as resources for renewable energy, Production of green energy: solar cell materials, fuel cell technology and catalytic pollution control.

References Books

1. Materials and Environment -Eco Informed Material Choice, M.F. Ashby, *Elsevier*.
2. Sustainable Energy without Hot Air, J.C. Mackay, *UIT Cambridge, England*.
3. Environmental Laws, Cases and Materials, P. Weinberg, *University Press of America*.
4. Fundamentals of Materials for Energy and Environmental Sustainability, D.S. Ginley, D. Cahen (Edited book), *Cambridge University Press*.
5. Environmental Ethics and Policy Book: Philosophy, Ecology, Economics, D.V. De Veer, *Wadsworth publisher.*

Material Science and Technology Lab - II
MMST-110

L	*P*	*Major Test: 60 marks*
0	*8*	*Minor Test: 40 marks*
		Total: 100 marks
		Time: 3hrs

1. To determine the melting point of metals through Differential Thermal Analysis (DTA).
2. To study the thermal decomposition of calcium oxalate ($CaC_2O_4.H_2O$) with the help of Thermogravimetry analysis (TGA) technique.
3. Estimate the purity of potassium chloride (KCl) and potassium sulphate (K_2SO_4) through Differential Thermal Analysis (DTA).
4. Determine the glass transition, crystallization and melting temperatures of Soda-lime glass.
5. To study the complete thermal profile of polymeric materials.
6. To study the optical properties of Potassium Permanganate ($KMnO_4$) Solutions through UV-visible spectroscopy.
7. Estimate the band gap of semi-conductors with the help of UV-visible spectroscopy.
8. Investigate thermal kinetics involved during the pyrolysis of biomass by using single heating rate kinetic model.
9. To separate the organic compounds from a given mixture by Colum Chromatography.
10. To determine the relative viscosity and specific viscosity of a given polymeric solution by using Ubbelohde viscometer.

Note: At least eight experiments will be performed by the students.

Polymer Science and Technology

MMST-201

L	*P*	
3	*0*	*Major Test: 60 marks* *Minor Test: 40 marks* *Total: 100 marks* *Time: 3hrs*

Unit - I

Basic Concepts: Specific features of polymer structure: regular, irregular polymers, chemical heterogenity, polydisperity, polar and non polar polymers; Classification of polymers, Polymerization mechanisms, Molecular weight of polymers: number-average, weight-average, Z-average and viscosity average; Chemical transformation of polymers: degradation, effect of high temperature, mechanical transformations, light and ionizing radiations, chemical degradation.

Unit - II

Glass Transition Temperature: Definition, Glassy solids and glass transition, Transition and associated properties, Factors affecting glass transition temperature, Glass transition temperature and molecular weight, Glass transition temperature and plasticizers, Glass transition temperature of co-polymers, Glass transition temperature and melting point, Importance of glass transition temperature, Heat distortion temperature, Determination of glass transition temperature.

Unit - III

Crystallinty in Polymers: Crystalline solids and their behaviour towards x-rays polymers and x-ray diffraction, Degree of crystallinity, Crystallisability, Crystallites, Helix structures, Spherulites, Polymer single crystals, Effect of crystallinity on preparation of polymers.

Unit - IV

Ceramics: Clays, Silica, Feldspars, Methods for fabrication of ceramic ware, Ceramic products, Glazes procelain and Vitreous enamels.

Composite Materials: Introduction, Constitution, Classification: particle-reinforced composites, fibre-reinforced composites, structural composites, hybrid composites; Processing of Fibre: reinforced composites, Applications of composite materials.

References Books

1. Physical Chemistry of Polymers, A. Tager, Mir Publishers.
2. A Text book of engineering Chemistry, S.S. Dara, S. Chand & Company Ltd.
3. Industrial Chemistry, O.P. Vermani, A.K. Narula, Galgotia Publications Pvt. Ltd.

Intelligent Macromolecules

MMST - 203

L	*P*	*Major Test: 60 marks*
3	*0*	*Minor Test: 40 marks*
		Total:100 marks
		Time: 3hrs

Unit - I

Concepts of Intelligent Macromolecules: Introduction, Synthetic macromolecules: chain structure, classification, synthesis, chain confirmation, macromolecular structure in solution, primary, secondary, tertiary and quaternary structures; Biological macromolecules: brief description of structure of DNA, proteins, polysaccharides; Carbon nanomaterials, Intelligent macromolecules.

Unit - II

Conducting Polymers: Introduction, Conjugated conducting polymers: structure, synthesis (soluble conjugated polymers, conjugated polymer films) and properties; Charge transfer polymers: organic charge transfer complexes, polymer charge transfer complexes, charge transfer between fullerene and polymers.

Dendrimers and Fullerene: Introduction, Dendrimers, Synthesis: divergent approach, convergent growth approach; Structure: dendrimer with a metal core, hollow core, hydrophobic interior and hydrophilic exterior layer, guest molecules trapped in their cavities; Fullerene: chemistry of C_{60} (addition reaction, dimerisation and polymerization), polymeric derivatives of C_{60} (fullerene charm bracelets, fullerene pearl necklace).

Unit - III

Carbon Nanotubes: Introduction, Structure, Properties, Synthesis: multi-wall, single wall; Purification, Microfabrication, Chemical modification: end-functionalisation (oxidation of carbon nanotubes, covalent coupling via oxidized nanotubes end), modification of nanotube outerwall, fuctionalisation of nanotube innerwall; Non-covalent chemistry of carbon nanotubes.

Unit - IV

Intelligent Macromolecules Applications: C_{60} superconductivity, Carbon nanotube Super-capacitors, Conducting polymer batteries, Carbon nanotube nano electronics: nano wires, super conductors, rings, nano circuits; Conjugated polymer sensors with electrical transducers: conductometric, potentiometric, ampermetric, volumetric.

References Books:

1. Intelligent Macromolecules for Smart Devices from Material Synthesis to Device Applications, L. Dia, *Springer, USA*.
2. Dendrimer Chemistry, F. Vögtle, G. Richardt, N. Werner, *John Wiley and Sons, Germany*.
3. Fullerenes: Principles and Applications, Edited by F. Langa, J.F. Nierengarten, *RSC publication*, *England*.

Green Chemistry

MMST - 205

L	*P*	*Major Test: 60 marks*
3	*0*	*Minor Test: 40 marks*
		Total: 100 marks
		Time: 3hrs

Unit - I

Green Chemistry: Introduction, Need for green chemistry: pesticides, chlorofluorocarbons, acid rain, global warming; Goals of green chemistry, Limitations in the pursuit of goals of green chemistry, Progress of green chemistry, Importance of green chemistry in daily life.

Unit -II

Principles of Green Chemistry and Designing of Chemical Synthesis: Twelve principles of green chemistry, Designing of green synthesis using these principles, Prevention of waste/byproducts, Atom economy: rearrangement reactions, addition reactions, substitution reactions, elimination reactions; Prevention/minimization of toxic products, Designing safer chemicals: selection of appropriate auxiliary substances (solvents, separation agents), green solvents, immobilized solvents, ionic liquids.

Unit - III

Green Synthesis Methods and Conversions: Microwave synthesis, Electro-organic synthesis, Thermo-chemical conversion: direct combustion, gasification; Biochemical conversion: anaerobic digestion, alcohol production from biomass.

Unit - IV

Green Synthesis/Reactions: Green synthesis of compounds: adipic acid, catechol, methyl acrylate, urethane, acetaldehyde, benzyl bromide, paracetamol.

References Books:

1. Green Reaction Media in Organic Synthesis, M. Koichi, *Wiley-Blackwell, USA.*
2. Introduction to Green Chemistry, V. Kumar, *Vishal Publishing Co., Jalandhar.*
3. Green Chemistry, R. Sanghi and M.M. Srivastava, *Narosa Publishing House, New Delhi.*

MTOE-201	Business Analytics						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	The main objective of this course is to give the student a comprehensive understanding of business analytics methods.						
Course Outcomes (CO)							
CO1	*Able to have knowledge of various business analysis techniques.*						
CO2	*Learn the requirement specification and transforming the requirement into different models.*						
CO3	*Learn the requirement representation and managing requirement assests.*						
CO4	*Learn the Recent Trends in Embedded and collaborative business*						

Unit 1

Business Analysis: Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst. Stakeholders: the project team, management, and the front line, Handling, Stakeholder Conflicts.
Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles.

Unit 2

Forming Requirements: Overview of Requirements Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents.
Transforming Requirements: Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling

Unit 3

Finalizing Requirements: Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements.
Managing Requirements Assets: Change Control, Requirements Tools

Unit 4

Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data Journalism.

References:

1. Business Analysis by James Cadle et al.
2. Project Management: The Managerial Process by Erik Larson and, Clifford Gray

MTOE-203	Industrial Safety						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	*To enable students to aware about the industrial safety.*						
Course Outcomes (CO)							
CO1	*Understand the industrial safety.*						
CO2	*Analyze fundamental of maintenance engineering.*						
CO3	*Understand the wear and corrosion and fault tracing.*						
CO4	*Understanding that when to do periodic inceptions and apply the preventing maintenance.*						

Unit-1

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, washrooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-2

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit-3

Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit-4

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Reference:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

MTOE-205	Operations Research						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	To enable students to aware about the dynamic programming to solve problems of discreet and continuous variables and model the real world problem and simulate it.						
Course Outcomes (CO)							
CO1	*Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.*						
CO2	*Students should able to apply the concept of non-linear programming*						
CO3	*Students should able to carry out sensitivity analysis*						
CO4	*Student should able to model the real world problem and simulate it.*						

Unit -1

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit -2

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit- 3

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit -4

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

MTOE-207	Cost Management of Engineering Projects						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	*To enable students to make aware about the cost management for the engineering project and apply cost models the real world projects.*						
Course Outcomes (CO)							
CO1	*Students should able to learn the strategic cost management process.*						
CO2	*Students should able to types of project and project team types*						
CO3	*Students should able to carry out Cost Behavior and Profit Planning analysis.*						
CO4	*Student should able to learn the quantitative techniques for cost management.*						

Unit-1

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Unit-2

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Unit-3

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Unit-4

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

MTOE-209	Composite Materials						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	*To enable students to aware about the composite materials and their properties.*						
Course Outcomes (CO)							
CO1	*Students should able to learn the Classification and characteristics of Composite materials.*						
CO2	*Students should able reinforcements Composite materials.*						
CO3	*Students should able to carry out the preparation of compounds.*						
CO4	*Student should able to do the analysis of the composite materials.*						

UNIT–1:

INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Iso-strain and Iso-stress conditions.

UNIT – 2

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–3

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – 4

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT BOOKS:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R.
3. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

MTOE-211	Waste to Energy						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	*To enable students to aware about the generation of energy from the waste.*						
Course Outcomes (CO)							
CO1	*Students should able to learn the Classification of waste as a fuel.*						
CO2	*Students should able to learn the Manufacture of charcoal.*						
CO3	*Students should able to carry out the designing of gasifiers and biomass stoves.*						
CO4	*Student should able to learn the Biogas plant technology.*						

Unit-1

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit-2

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit-3

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit-4

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

References:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

MTAD-101	English For Research Paper Writing						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Student will able to understand the basic rules of research paper writing.*						
Course Outcomes (CO)							
CO1	*Understand that how to improve your writing skills and level of readability*						
CO2	*Learn about what to write in each section*						
CO3	*Understand the skills needed when writing a Title*						
CO4	*Ensure the good quality of paper at very first-time submission*						

Unit 1

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Unit 2

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Unit 3

Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check. key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

Unit 4

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

References:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

MTAD-103	Disaster Management						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Develop an understanding of disaster risk reduction and management*						
Course Outcomes (CO)							
CO1	*Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.*						
CO2	*Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.*						
CO3	*Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.*						
CO4	*critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in*						

Unit 1

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Unit 2

Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

Unit 3

Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Unit 4

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival. Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs Of Disaster Mitigation in India.

References:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep &Deep Publication Pvt. Ltd., New Delhi.

MTAD-105	Sanskrit for Technical Knowledge						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Students will be able to Understanding basic Sanskrit language and Ancient Sanskrit literature about science & technology can be understood and Being a logical language will help to develop logic in students*						
Course Outcomes (CO)							
CO1	*To get a working knowledge in illustrious Sanskrit, the scientific language in the world*						
CO2	*Learning of Sanskrit to improve brain functioning*						
CO3	*Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power*						
CO4	*The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature*						

Unit –1

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences.

Unit – 2

Order, Introduction of roots,Technical information about Sanskrit Literature

Unit –3

Technical concepts of Engineering: Electrical, Mechanical

Unit –4

Technical concepts of Engineering: Architecture, Mathematics

References

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

MTAD-107	Value Education						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Understand value of education and self- development, Imbibe good values in students and Let the should know about the importance of character*						
Course Outcomes (CO)							
CO1	*Knowledge of self-development*						
CO2	*Learn the importance of Human values*						
CO3	*Developing the overall personality*						
CO4	*Know about the importance of character*						

Unit 1

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements.

Unit 2

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism.Love for nature,Discipline

Unit 3

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

Unit 4

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence,Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

References

1.Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

MTAD-102	Constitution of India						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective and to address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.*						
Course Outcomes (CO)							
CO1	*Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.*						
CO2	*Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.*						
CO3	*Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.*						
CO4	*Discuss the passage of the Hindu Code Bill of 1956.*						

Unit I

History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working) Philosophy of the Indian Constitution: Preamble, Salient Features

Unit 2

Contours of Constitutional Rights & Duties: Fundamental Rights , Right to Equality , Right to Freedom , Right against Exploitation , Right to Freedom of Religion, Cultural and Educational Rights , Right to Constitutional Remedies , Directive Principles of State Policy , Fundamental Duties.

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive , President, Governor , Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications. Powers and Functions

Unit 3

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation, Panchayati raj: Introduction, PRI: ZilaPanchayat, Elected officials and their roles, CEO ZilaPanchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

Unit 4

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

References

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

MTAD-104	Pedagogy Studies						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Review existing evidence on the review topic to inform programme design and policy making undertaken by the DFID, other agencies and researchers and Identify critical evidence gaps to guide the development.*						
Course Outcomes (CO)							
CO1	*What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?*						
CO2	*What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?*						
CO3	*How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?*						
CO4	*What is the importance of identifying research gaps?*						

Unit 1

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology , Theories of learning, Curriculum, Teacher education., Conceptual framework, Research questions. Overview of methodology and Searching. Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. , Curriculum, Teacher education.

Unit 2

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

Unit 3

Professional development: alignment with classroom practices and follow-up support, Peer support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes,

Unit 4

Research gaps and future directions: Research design, Contexts , Pedagogy, Teacher education Curriculum and assessment, Dissemination and research impact.

References

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.

MTAD-106	Stress Management by Yoga						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	To achieve overall health of body and mind and to overcome stress						
Course Outcomes (CO)							
CO1	*Develop healthy mind in a healthy body thus improving social health.*						
CO2	*Improve efficiency*						
CO3	*Learn the Yog asan*						
CO4	*Learn the pranayama*						

Unit – 1

Definitions of Eight parts of yog (Ashtanga).

Unit- 2

Yam and Niyam, Do`s and Don't's in life; Ahinsa, satya, astheya, bramhacharya and aparigraha; Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.

Unit- 3

Asan and Pranayam, Various yog poses and their benefits for mind & body,

Unit- 4

Regularization of breathing techniques and its effects-Types of pranayam.

References

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

MTAD-108	Personality Development through Life Enlightenment Skills						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	To learn to achieve the highest goal happily To become a person with stable mind, pleasing personality and determination To awaken wisdom in students						
Course Outcomes (CO)							
CO1	*Students become aware about leadership.*						
CO2	*Students will learn how to perform his/her duties in day to day work.*						
CO3	*Understand the team building and conflict*						
CO4	*Student will learn how to become role model for the society.*						

Unit – 1

Neetisatakam-Holistic development of personality: Verses: 19, 20, 21, 22 (wisdom); Verses: 29, 31, 32 (pride & heroism); Verses: 26, 28, 63, 65 (virtue); Verses: 52, 53, 59 (don's); Verses: 71, 73, 75, 78 (do's).

Unit – 2

Approach to day to day work and duties; Shrimad Bhagwad Geeta: Chapter-2: Verses: 41, 47, 48; Chapter-3: Verses: 13, 21, 27, 35; Chapter-6: Verses: 5, 13, 17, 23, 35; Chapter-18: Verses: 45, 46, 48.

Unit - 3

Statements of basic knowledge; Shrimad Bhagwad Geeta: Chapter-2: Verses: 56, 62, 68; Chapter-12: Verses: 13, 14, 15, 16, 17, 18.

Unit – 4

Personality of Role model; Shrimad Bhagwad Geeta: Chapter-2: Verses: 17; Chapter-3: Verses: 36, 37, 42: Chapter-4: Verses: 18, 38, 39; Chapter-18: Verses: 37, 38, 63.

References:

1. Srimad Bhagavad Gita, Swami Swarupananda Advaita Ashram (Publication Department), Kolkata.
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya), P. Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Dissertation Part – I and Dissertation Part - II

	Dissertation Part-I (MMST-207) and Dissertation Part-II (MMST-202)
Course Outcomes (CO)	
CO1	Ability to synthesize knowledge and skills previously gained and applied to an in depth study and execution of new technical problem.
CO2	Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
CO3	Ability to present the findings of their technical solution in a written report.
CO4	Presenting the work in International/ National conference or reputed journals.

Syllabus Contents:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the following:

Relevance to social needs of society
Relevance to value addition to existing facilities in the institute
Relevance to industry need
Problems of national importance
Research and development in various domain

The student should complete the following:

Literature survey Problem Definition
Motivation for study and Objectives
Preliminary design / feasibility / modular approaches
Implementation and Verification
Report and presentation

The dissertation part- II is based on a report prepared by the students on dissertation allotted to them. It may be based on:

Experimental verification / Proof of concept.
The viva-voce examination will be based on the above report and work.

Guidelines for Dissertation Part – I and Dissertation Part - II

As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two parts i.e. Part– I: July to December and Part– II: January to June.

The dissertation may be carried out preferably in-house i.e. department's laboratories and centers OR in industry allotted through department's T & P coordinator.

After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives.

The referred literature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals in the areas of Computing Engineering and any other related domain. In case of Industry sponsored projects, the relevant application notes, white papers, product catalogues should be referred and reported.

Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.

Part–I deliverables: A document report comprising of summary of literature survey, detailed objectives, project specifications, paper, proof of concept/functionality, part results, and record of continuous progress.

Part–I evaluation: A committee comprising of guides of respective specialization shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend repeating the Part-I work.

During Part– II, student is expected to exert on design, development and testing of the proposed work as per the schedule. Accomplished results/contributions/innovations should be published in terms of research papers in reputed journals and reviewed focused conferences OR IP/Patents.

Part–II deliverables: A dissertation report as per the specified format, developed system in the form of hardware and/or software, and record of continuous progress.

Part-II evaluation: Guide along with appointed external examiner shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend for extension or repeating the Part-I work.