POOJYA DODDAPPA APPA COLLEGE OF ENGINEERING, KALABURAGI

Scheme of Teaching and Examinations – 2024

M.Tech Materials Science and Technology (MST)

Choice Based Credit System (CBCS) and Outcome Based Education(OBE)

II SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week			Examination				Credits
				Theory	Practical/ Seminar	Tutorial/ Skill Development Activities	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1	IPCC/PCC	24MST21	Characterization of Materials	03	00	02	03	50	50	100	**4**
2	PCC/PBLC	24MST22	Mechanical Behavior & Testing of Materials	02	00	02	03	50	50	100	3
3	PCC	24MST23	Electrical and Magnetic Materials	02	02	00	03	50	50	100	3
4	PEC	24MST24x	Professional elective 1	02	00	02	03	50	50	100	3
5	PEC	24MST25x	Professional elective 2	02	00	02	03	50	50	100	3
6	MPS	24MPS26	Mini Project/Technology-Based Societal	00	04	02	--	100	--	100	3
7	PCCL	24MSTL27	Data Interpretation & Analysis Lab	01	02	00	03	50	50	100	2
8	AEC/SEC	24MST28x	Ability/Skill Enhancement Course (Offline/Online)	00 01	02 00	--- ----	02 01	50	50	100	1
TOTAL				**13**	**10**	**10**	**21**	**450**	**350**	**700**	**22**

Note: **BSC**-Basic Science Courses, **PCC**: Professional core. **IPCC**-Integrated Professional Core Courses, **NCMC**- None Credit Mandatory Course, **PCCL**-Professional Core Course lab

AUD/AEC/SEC–Audit Course / Ability Enhancement Course/Skill Enhancement Course, **L-Lecture, P-Practical, T/SDA-Tutorial / Skill Development Activities** (Hours are for Interaction between faculty and students) **PBLC**: Project Based Learning Course, **MPS**: Mini Project with Seminar/ Societal Project with Seminar

Professional Elective 1		**Professional Elective 2**	
Course Code under 24MST23X	**Course title**	**Course Code under**	**Course title**
24MST241	Non-Destructive Testing of Engineering Materials	24MST251	Ceramic Engineering
24MST242	Smart Materials	24MST252	Biomaterials
24MST243	Engineering Composites	24MST253	Physical Metallurgy

Ability / Skill Enhancement Courses			
24MST271	Introduction to Biomaterials	24MST275	Iron and Steel Making
24MST272	Principles of Physical Metallurgy	24MST276	Nanomaterials and their applications
24MST273	Thermodynamics and Kinetics of Materials	24MST277	Solar Photovoltaic
24MST274	Science and Technology of Polymers	24MST278	Fundamentals of Materials Processing

Note:

Integrated Professional Core Course (IPCC): Refers to a Professional Theory Core Course Integrated with practical of the same course. The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper.

Project Based Learning Course (PBLC): Project Based Learning Course is a professional core Course only Students have to complete a project out of learning from the course and SEE will be viva voce on project work

1 Mini Project/ Societal with Seminar: This may be hands-on practice**,** survey report, data collection and analysis, coding, mobile app development, field visit and report preparation, modelling of system, simulation, analysing and authenticating, case studies, etc. It may be Techno Societal Project, technical Project work useful for the society.

CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any, and a senior faculty of the department. Students can present the seminar based on the completed mini-project/Societal Project. Participation in the seminar by all postgraduate students of the program shall be mandatory.

The CIE marks awarded for Mini/Societal Project work and Seminar, shall be based on the evaluation of Mini/ Societal Project work and Report, Presentation skill and performance in Question-and-Answer session in the ratio 50:25:25. Mini-Project with Seminar shall be considered as a head of passing and shall be considered for vertical progression as well as for the award of degree. Those, who do not take-up/complete the Mini Project and Seminar shall be declared as fail in that course and have to complete the same during the subsequent semester. **There is no SEE for this course.**

Audit Courses /Ability Enhancement Courses Suggested by BOS (ONLINE courses): Audit Courses: These are prerequisite courses suggested by the concerned Board of Studies. Ability Enhancement Courses will be suggested by the BoS if prerequisite courses are not required for the programs. **Ability Enhancement Courses**:

- These courses are prescribed to help students to enhance their skills in in fields connected to the field of specialisation as well allied fields that leads to employable skills. Involving in learning such courses are impetus to lifelong learning.
- The courses under this category are online courses published in advance and approved by the concerned Board of Studies.
- Registration to Audit /Ability Enhancement Course shall be done in consultation with the mentor and is compulsory during the concerned semester.
- In case a candidate fails to appear for the proctored examination or fails to pass the selected online course, he/she can register and appear for the same course if offered during the next session or register for a new course offered during that session, in consultation with the mentor.
- The Audit Ability Enhancement Course carries no credit and is not counted for vertical progression. However, a pass in such a course is mandatory for the award of the degree.

Course Title: Characterization of Materials		
Subject Code	24MST21	CIE: 50
Number of Lecture Hours/Week	4 (Theory) Credits- 4	SEE: 50
Total Number of Hours	52	SEE Hours: 03

Prerequisite: Basic materials science knowledge at the undergraduate level

Course Objective: To impart knowledge and enable students to understand

1. X-ray diffraction technique and X-ray diffractometer and phase determination by XRD
2. Effect of parameters the peak shifting peaksplitting and peakintancity of XRD pattern
3. SEM, TEM and their utilization to study the microstructure and morphology
4. Thermal analysis techniques and spectroscopic techniques and Instruments

S. No.	Modules	Teaching Hours
1	**Module-I** Review of fundamentals of Materials Science, Diffraction, Interference, X-ray Diffraction technique Braggs law, X-rays, production of X-rays and their properties, X-ray diffractometers, Determination of crystal structure by XRD , Phase identification and quantification by XRD, Plane indexing, Calculation of lattice parameter. Factors affecting intensity of peaks in XRD pattern such as structure factor, Lorenz factor, temperature factor etc	**10 Hours**
2	**Module-II** XRD graph analysis significant information from peak broadening, Determination crystallite sites, scherrer formula by using XRD graphs, Determination crystallite sites, and strain in material by Williams Hall plot using XRD graphs, significant information from peak shifting, peak intensity, Peak splitting, number of peaks, Problems on analysis of XRD graphs of peak intensity, peak position, peak shifting, peak splitting and umber of peaks. Systematic absences of planes (hkl) in xrd pattern due to symmetry crystal structure. Problems on systematic absences	**10 Hours**
3	**Module-III** Electron microscopy, SEM instrumentation, Theory of SEM, principle and operation, Resolution and magnification, Specimen handling and preparation, Analysis of SEM graphs, TEM, principle and operation, Analysis and application of TEM, Analysis of SAD(selected area diffraction) & EDEX, Comparison of SEM and TEM, AFM principle, operation & applications	**10 Hours**
4	**Module-IV** Thermal analysis- Principle Construction , applications of TGA, Analysis of TGA curves & advantages of TGA, Parameters affecting TGA curve, Characteristics of sample powder affecting TGA curves ., Principle, construction operation& analysis of DTA, DTG and DSC. Principle, operation& analysis of Particle size, surface area determination by BET.	**11 Hours**

	Principle, operation, analysis and applications of FTIR. Principle, operation, analysis and applications of UV visible Spectroscopy. Principle , working, construction and applications of Raman spectroscopy	
5	**Module-V** Vibrating scanning magnetometer VSM, Analysis of Hysteresis loops and Magnetic property by VSM ,Mossbauer spectroscopy, NMR -principle ,operation & applications ,ESCA,ESRPL principle operation & applications, Electron energy loss spectroscopy(EELS), Reflection absorption infrared spectroscopy (RAIRS), XPS -principle, operation & applications Photoelectron spectroscopy(PES), Auger electron spectroscopy(AES) ,Extended x-ray absorption fine structure,) EXAFAS X-ray fluorescence (XRF)	**11 Hours**

Question paper pattern:

Question paper to be framed for hundred marks containing ten questions of twenty marks each and mandatorily two questions from each module. Each question may be split up to maximum four subdivisions. The student to answer mandatorily one full question from each module so that students will answer five questions which maximize marks to one hundred**.**

Text books:

Reference Books:

1.C.Giacovazzo Editor "Fundamentals of Crystallography" International Union of Crystallography Oxford University Press 1994

2. Cullity B. D. "Elements of X-ray Diffraction" Addison-Wesley Publishing Co.

3. C. Suryanarayana "X-ray Diffraction: A Practical Approach" M.Grant Norton Plenum Press NewYork 1998

4.P.J. Goodhew, F.J. Humphreys Electron Microscopy and Analysis, , 2nd edition Taylor & Francis publications

5. Antony R. West "Solid state chemistry and its Applications" Wiley Student Edition. 2008

6. Colin N. Banwell and Elaine M. McCash "Fundamentals of Molecular spectroscopy" Tata McGraw Hill Publishing Co. Ltd., Fourth edition.

Course outcomes:

On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
24MST21	**CO1**	Analyse the phase of material and crystal stricture of given compound by XRD data and Pattern
	CO2	Analyse and Interpret the peak shifting peaksplitting and peakintancity and XRD
	CO3	Analyse and Interpretation of the Micrographs obtained from Microscopy
	CO4	Analyse of thermal behavior of materials using DT-TGA and identification of functional group by FTIR
	CO5	Evaluation and applications of advanced characterization techniques

Course Title: Mechanical Behavior & Testing of Materials				
Subject Code	24MST22			CIE: 50
Number of Lecture Hours/Week	2 (Theory)+2 PCC	Credits	3	SEE: 50
Total Number of Lecture Hours	42			SEE Hours: 03
Prerequisite: Basic materials science knowledge at the undergraduate level				
Course Objective: To impart elementary knowledge about structure-property correlations and phase transformation in metals and alloys				

Modules	**Contents**	**Teaching Hours**
I	Crystal structure of materials, solidification of pure metals, homogenous and heterogeneous nucleation processes, Iron-Carbide phase diagram. Introduction to mechanical Properties; Tensile strength, compressive strength, ductility, malleability, stiffness, toughness, creep strength, hardness, impact and fatigue strength	**8 Hours**
II	Elastic and Plastic deformation in metals, slip planes and direction in crystals, critically resolved shear stress. Plastic deformation in metals: strain hardening and annealing of cold worked metals. Deformation behavior in polymers. Strengthening mechanism of metals and alloys; Grain boundary strengthening, solid solution strengthening, second phase particle strengthening, martensitic strengthening	**8 Hours**
III	Composite Strengthening; Significance of composites, fibre strengthened composites, effect of fiber orientation and concentration, isostress and strain conditions, mechanism of deformation of composites, influence of fiber length, dispersion strengthened composites, Strengthening of plastics. Toughening in ceramics; Crack deflection, Transformation toughening like partially stabilized zirconia, crack bridging and microcrack toughening	**10 Hours**
IV	Tensile behaviors; Tension test and stress-strain curves, tensile properties. Scratch and Indentation hardness, Brinell hardness test and its limitation, Vickers hardness test and its limitation, Rockwell hardness test and its limitations, Microhardness test. Ductile-brittle transition behavior and Behavior of polymers under impact loading	**8 Hours**
V	Ductile fracture, brittle fracture, mechanism of brittle fracture. Fracture toughness test, fracture stress test, hardness indentation method. Fatigue behavior of materials, Fatigue test, Mechanism of fatigue. Creep behavior of materials, creep curves, mechanism of creep deformation	**8 Hours**

Question paper pattern:
Question paper to be framed for hundred marks containing ten questions of twenty marks each and mandatorily two questions from each module. Each question may be split up to maximum four subdivisions. The student to answer mandatorily one full question from each module so that students will answer five questions which maximize marks to one hundred**.**

Text books:
A.K. Bhargava and C. P. Sharma "Mechanical Behaviour and Testing of Materials PHI Learning Private Limited New Delhi 2011

Reference Books:
Williams F Smith, Javad Hashemi and Ravi Prakash, "Materials Science and Engineering" 5th Edition, McGraw Hill Education (India) Pvt. Limited New Delhi 3. V. Raghavan ,"Physical Metallurgy" Prentice Hall of India Pvt. Ltd New Delhi

Course outcomes:
On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)	Blooms Level
24MST22	**CO1**	Explain crystal structure, imperfection, solid solutions and mechanical properties of materials	**L2**
	CO2	Distinguish elastic and plastic deformation mechanisms and its impact on strain hardening and cold working of metals and alloys	**L4**
	CO3	Analysis of microstructure-property correlations for enhancement of materials strengthening	**L4**
	CO4	Evaluation and Interpretation of experimental results of mechanical properties	**L4**
	CO5	Analysis of causes for materials failure and set threshold values for sustainability	**L4**

Course Title: Electrical and Magnetic Materials					
Subject Code	24MST23				CIE: 50
Number of Lecture Hours/Week	2 + 2 hours SDA	Theory	Credits	3	SEE: 50
Total Number of Hours	40				SEE Hours: 03
Prerequisite: Basic materials science knowledge at the undergraduate level					

Course Objective: To impart knowledge to

1. Conceptualize basic of electrical conductors, insulators, semiconductors and dielectric materials
2. Establish structure-property correlations for properties such as piezoelectric, ferroelectric, electro-optic, magnetic materials
3. Infer the composition and functions of capacitors, transducers, ceramic sensors and ZnO varistors
4. Familiarize the mechanisms of ionic conductivity and superconductivity

Modules	**Contents**	**Teaching Hours**
I	Electrical conduction in metals; Classic model for electrical conduction in metals, drift velocity of electrons in a conducting metal, electrical resistivity of metals, energy band models for electrical conduction in metals and insulators. Intrinsic and extrinsic semiconductors, semiconductors devices and microelectronics. Applications of p-n junction diode.	**8 Hours**
II	Properties of insulators and materials applications{| as insulators. Linear and Non-linear dielectrics; Classification, Dielectric constant, Dielectric strength and Dielectric breakdown mechanism. Classification of Class-I, Class-II and Class-III capacitors, varieties of film capacitors, discrete capacitors and multilayer capacitors. Processing and fabrication (Tape Casting) of multilayer capacitors	**8 Hours**
III	Effect of piezoelectricity, pyro-electricity and ferro-electricity phenomenon. Structure and origin of ferroelectric state. Hysteresis behavior of ferroelectric state. Basic relationship and phenomena of electro-optic ceramics, optical phase retardation, PLZT compositional system, processing and fabrication of PLZT.	**8 Hours**
IV	Elementary idea of ionic conductivity, Solid electrolytes and fast ion conductors; Solid oxide fuel cells construction, working principles and fuel cell materials. Superconductivity phenomena, Meissner effect, types of superconductors, application and future scope.	**10 Hours**

	Basic theory of magnetism and magnetic properties. Definition and examples of diamagnetism, paramagnetism, ferromagnetism, anti-ferromagnetism and ferrimagnetisms.	
V	Classes of magnetic ceramics; spinal ferrites structure, spinel spin lattice interactions, effect of composition in ferrites, effect of thermal treatment, manganese and nickel zinc ferrite and hexagonal ferrites, structure, properties and applications. Rare earth garnets, YIG structure, properties and applications. Preparation methods of magnetic materials; processing and fabrication techniques	**8 Hours**

Question paper pattern:

Question paper to be framed for hundred marks containing ten questions of twenty marks each and mandatorily two questions from each module. Each question may be split up to maximum four subdivisions. The student to answer mandatorily one full question from each module so that students will answer five questions which maximize marks to one hundred**.**

Text books:

Reference Books:

1.Hench L.L. and West J.K. “Principles of Electronic Ceramics” A Wiley-Interaction Publication John Wiley and Sons USA 1989

2.Relva C. Buchana “Ceramic Materials for Electronics-Processing, Properties and Applications” Marcel Dekker Inc. New York 1986

3.David W. Richerson “Modern Ceramic Engineering- Properties, Processing and Use in Design” Marcek Dekker Inc.,New York 1992

4.Williams F Smith, Javad Hashemi and Ravi Prakash, "Materials Science and Engineering" 5th Edition, McGraw Hill Education (India) Pvt. Limited New Delhi

Course outcomes:

On completion of the course, the student will have the ability to:

Course Code	**CO #**	**Course Outcome (CO)**
24MST23	**CO1**	Explain the basics of electrical conductors, semiconductors and insulators
	CO2	Analysis and applications of dielectric materials and capacitors
	CO3	Interpretation of ferroelectric behavior and electro-optic materials properties
	CO4	Explain the working and applications of electronic devices related sensors and sofc
	CO5	Analysis and evaluation of magnetic materials compositions and processing

Professional Elective-1: 24MST24X

Course Title: Non Destructive Testing for Engineering Materials				
Subject Code	**24MST241**			CIE: 50
Number of Lecture Hours/Week	2 Theory 2 SDA	Credits	3	SEE: 50
Total Number of Lecture Hours	42			SEE Hours: 03
Prerequisite: No specific Requirements				
Course Objectives: To impart knowledge about Non-Destructive Testing Methodologies adopted for testing of materials as per ASTM standards				

Modules	**Contents**	**Teaching Hours**
I	Introduction to NDT**:** Selection of NDT methods. Visual inspection, leak testing, Liquid penetration inspection- advantages and limitations.	8
II	Magnetic particle inspection**:** Methods of generating magnetic field, types of magnetic particles and suspension liquids, steps in inspection, applications and limitations of the test. Eddy current inspection**:** principle of operation, process variables , inspection coils- applications and limitations the test	8
III	Ultrasonic inspection**:** Basic equipment, characteristics of ultrasonic waves, variables during ultrasonic inspections. Inspection methods, normal incident pulse echo, angle beam pulse echo and transmission type. Method of display- A, B and C scan mode. Transducer elements, couplets, search units, contact type and immersion types inspection methods, inspection of products like casting, extrusions, rolled product, weld set- applications and limitations of the test	10
IV	Radiography inspection**:** Principles, radiation sources. X-Rays and their generation, gamma rays and their generation. Radio graphic films. X-ray filters image intensifiers. Industrial radiography. Image quality indicators, radiography sensitivity- applications and limitations of the test. Neutron radiography: working methodology its application and limitations. Thermal NDT**:** principle, inspection methods, applications and limitations of the test	8
V	Optical Holography**:** Basics of Holography, recording and reconstruction-info metric techniques of inspection, procedures of inspection, typical applications. Acoustical Holography: working principle, applications and limitations. Microwave NDT: Working principle, applications and limitations.	8

Question paper pattern:
Question paper to be framed for hundred marks containing ten questions of twenty marks

each and mandatorily two questions from each module. Each question may be split up to maximum four subdivisions. The student to answer mandatorily one full question from each module so that students will answer five questions which maximize marks to one hundred**.**

Text books:

1. Non-Destructive Testing Techniques- by Ravi Prakash, first revised edition, new age international publications.
2. Basics of Non-Destructive testing- by Lari and Kumar, S.K. Kataria & Sons publication.
3. Non-Destructive Test and Evaluation of Materials- by J. Prasad and C.G.K.Nair,2nd edition, Mcgraw Higher Ed publication.

Reference Books:

1. Mc Gonnagle JJ "Non Destructive testing" – Garden and reach New York
2. Non destructive Evolution and quality control" volume 17-metals hand book, 9th edition Asia internal 1989
3. Davis H.E Troxel G.E Wiskovil C.T "The Testing instruction of Engineering materials" Mcgraw Higher Ed publication.

Course outcomes:

On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)	Blooms Level
24MST241	**CO1**	Find the basic differences between N D T and destructive testing and liquid penetrant NDT methods.	L2
	CO2	Illustrate magnetic particle and leak testing and handle the both tests.	L4
	CO3	Utilize Ultrasonic testing tools and outline their advantages and limitations	L4
	CO4	Examine the components for defects using X-ray, Gamma ray and by Neutron radiographic non destructive testing tools and outline their advantages and limitations	L4
	CO5	Explain t h e Optical Holographic, Acoustic holographic and microwave NDT methods and assesstheir applications and limitations	L4

Professional Elective-2: 24MST25X

Course Title: Ceramic Technology				
Subject Code	**24MST251**			CIE: 50
Number of Lecture Hours/Week	2 (Theory) 2 (SDA)	Credits	3	SEE: 50
Total Number of Lecture Hours	42			SEE Hours: 03
Prerequisite: No Specific Requirements				
Course Objective: To impart knowledge and enable students to understand the 1. Definition classification scope of ceramic materials 2. Ceramic raw materials and principles of ceramic processing 3. Preparation, properties and applications of claywares, refractories, glasses and cement 4. Composition, fabrication and applications of specific advanced ceramics				

Modules	**Contents**	**Teaching Hours**
I	History of development of ceramics from traditional to engineering ceramics, classification of ceramic products, applications of ceramic products, scope for ceramic products and industries, advantages and limitation of ceramics over polymers and metals. Industrial and synthetic raw materials for ceramic products; Quartz, polymorphism of quartz, feldspar and its classification, cornish stone, nephelyne syanite, talc, steatite, pyrophyllite, sericite, pyrophyllite, mica.	**8 Hours**
II	General manufacturing process of ceramics products; size reduction equipments, mixing, blending, shaping techniques, and drying methods. Design and working principles of furnaces and pyrometry.	**8 Hours**
III	Different kinds of clay and non-clay plastic materials, properties of kaolin mineral clays. Classification, preparation, properties, applications of clay products Definition of refractories, classification, refractories preparation, properties, testings and applications.	**8 Hours**
IV	Glass formation, glass melting process, glass viscosity versus temperature. Different kinds of glasses their properties and applications. Cement definition, different types of cement, Thermochemistry of clinkerizaion and hydration reaction of ordinary Portland cement and testings.	**8 Hours**
V	Newer ceramics: Classification – cermets and abrasives, electro-ceramics, bio-ceramics, space ceramics, super	**10 Hours**

	conducting ceramics, automotive ceramics. Elementary idea of their preparation and their application, evaluation of ceramics (Mechanical and thermal properties)	

Question paper pattern:
Question paper to be framed for hundred marks containing ten questions of twenty marks each and mandatorily two questions from each module. Each question may be split up to maximum four subdivisions. The student to answer mandatorily one full question from each module so that students will answer five questions which maximize marks to one hundred**.**

Text books: NA

Reference Books:

1.F. Singer and Singer S.S. " Industrial ceramics" Springer Publications ISBN 978902752596
2. F.H. Nortan "Elements of Ceramics" Longman Higher Education; 2nd Revised edition edition (1 June 1974) ISBN-10:0201053063, ISBN-13:978-0201053067
3.Solomon Mushikant "What every engineer should know about ceramics" Marcel and Dekker New york 1992.
4.W . Rayon "Properties of Ceramic Raw Materials" Elsevier 2003
5.A. Rashid Chesti "Refractories – Manufacture, Properties and Applications" Prentice Hall of India Pvt. Ltd.
6. S N Ghosh "Portland and blended Cements" A.H. Wheeler Publishing, Allahabad, Ed. 1980.
7.Samuel Ray Scholes, Charles H. Greene "Modern Glass Practice" Canners books 1975
8.Shigeyuki Somiya "Advanced Technical Ceramics" Academic Press Inc., Harcourt Brace Jovanovich Publishers, 1984
9.L. Coes Jr. "Abrasives" Springer-Verlag 1971.

Course outcomes:
On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)	Blooms Level
22MST251	**CO1**	Classify the ceramics and compare them with polymers and metals	**L2**
	CO2	Explain general raw materials of ceramics and processing of ceramics	**L2**
	CO3	Illustration of preparation, properties and applications of clay, triaxial compositions and refractories	**L2**
	CO4	Illustration of preparation, properties, applications of glass and cement and their evaluation	**L2**
	CO5	Describe the properties and applications of advanced ceramics	**L2**

Course Title: Mini Project/ Societal with Seminar:				
Subject Code	**24MST26**			CIE: 100
Number of Lecture Hours/Week	4+2 (Tutorial)	Credits	3	SEE: NA
Total Number of Practical Hours	42			SEE Hours: NA
Prerequisite: No Specific Requirements				

Course Objective: To impart knowledge and enable students for hands-on practice**,** survey report, data collection and analysis, coding, mobile app development, field visit and report preparation, modeling of system, simulation, analyzing and authenticating, case studies, etc. It may be Techno Societal Project, technical Project work useful for the society.

Evaluation Procedure

CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any, and a senior faculty of the department. Students can present the seminar based on the completed mini-project/Societal Project. Participation in the seminar by all postgraduate students of the program shall be mandatory.

The CIE marks awarded for Mini/Societal Project work and Seminar, shall be based on the evaluation of Mini/ Societal Project work and Report, Presentation skill and performance in Question-and-Answer session in the ratio 50:25:25. Mini-Project with Seminar shall be considered as a head of passing and shall be considered for vertical progression as well as for the award of degree. Those, who do not take-up/complete the Mini Project and Seminar shall be declared as fail in that course and have to complete the same during the subsequent semester. **There is no SEE for this course.**

Course outcomes:

On completion of the course, the student will have the ability to:

Professional Core Course Laboratory				
Subject Code	**24MSTL27-** Data Interpretation of Instrumental Analysis			CIE: 50
Number of Lecture Hours/Week	1 (Theory) 2 (Practical)	Credits	2	SEE: 50
Total Number of Hours	25			SEE Hours: 03
Prerequisite: Basic materials science knowledge at the undergraduate level				
Course Objective: To impart knowledge and enable students to understand 1. To acquire skills of conducting experiments individually regarding materials preparation and testing				

Experiment No.	**Contents**	**Teaching Hours**
1	FTIR Spectrum Analysis	2
II	DTA/TGA Graph analysis	2
III	Analysis of Data obtained from Dilatometer	2
IV	TEM micrograph analysis of nanoparticles	2
V	SEM Micrograph analysis of Sintered Products	2
VI	Data analysis of Mercury Intrusion Porosimeter	2
VII	Determination of density of sintered ceramic / metal powders	2
VIII	Measurement of particle size from TEM Micrograph and curve fitting	2
IX	Specifications of Refractories	2
X	Viscosity analysis of glass at different temperature	2
XI	Phase analysis using XRD data	2
XII	Determination of RUL of refractory	2