VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI.

Scheme of Teaching and Examinations and Syllabus
MTech Material Science & Technology **(MST)**
(Effective from Academic year 2020 - 21)

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2020 - 21
M Tech MATERIAL SCIENCE & TECHNOLOGY (MST)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

I SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical	Skill Development Activities (SDA)	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	20MST11	**Applied Mathematics**	03	--	02	03	40	60	100	4
2	PCC	20 MST12	Computational Techniques	03	--	02	03	40	60	100	4
3	PCC	20 MST13	Materials for Cryogenic & High Temperature applications	03	--	02	03	40	60	100	4
4	PCC	20 MST14	Nano Science & Nano Materials	03	--	02	03	40	60	100	4
5	PCC	20 MST15	Mechanical Behaviour of thin films	03	--	02	03	40	60	100	4
6	PCC	20 MSTL16	Material Characterization Lab - 1	--	04	--	03	40	60	100	2
7	PCC	20RMI17	Research Methodology and IPR	02	--	--	03	40	60	100	2
TOTAL				**17**	**04**	**10**	**21**	**280**	**420**	**700**	**24**

Note: PCC: Professional core.

Skill development activities:

Students and course instructor/s to involve either individually or in groups to interact together to enhance the learning and application skills.

The students should interact with industry (small, medium and large), understand their problems or foresee what can be undertaken for study in the form of research/ testing / projects, and for creative and innovative methods to solve the identified problem.

The students shall

(1) Gain confidence in modelling of systems and algorithms.

(2) Work on different software/s (tools) to Simulate, analyse and authenticate the output to interpret and conclude. Operate the simulated system under changed parameter conditions to study the system with respect to thermal study, transient and steady state operations, etc.

(3) Handle advanced instruments to enhance technical talent.

(4) Involve in case studies and field visits/ field work.

(5) Accustom with the use of standards/codes etc., to narrow the gap between academia and industry.

All activities should enhance student's abilities to employment and/or self-employment opportunities, management skills, Statistical analysis, fiscal expertise, etc.

Internship: All the students have to undergo mandatory internship of 6 weeks during the vacation of I and II semesters and /or II and III semesters. A University examination shall be conducted during III semester and the prescribed credit shall be counted for the same semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail in internship course and have to complete the same during the subsequent University examination after satisfying the internship requirements.

Note: (i) Four credit courses are designed for 50 hours Teaching – Learning process.
(ii) Three credit courses are designed for 40 hours Teaching – Learning process.
(iii) Two credit courses are designed for 25 hours Teaching – Learning process

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II SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week			Examination				Credits
				Theory	Practical/ seminar	Skill Development Activities (SDA)	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	20 MST21	Smart Materials & Structures	03	--	02	03	40	60	100	4
2	PCC	20 MST22	Testing of Materials	03	--	02	03	40	60	100	4
3	PCC	20XXX23	Advanced Foundry Technology	03	--	02	03	40	60	100	4
4	PEC	20 MST24X	Professional elective 1	04	--	--	03	40	60	100	4
5	PEC	20 MST25X	Professional elective 2	04	--	--	03	40	60	100	4
6	PCC	20 MSTL26	Material Characterization Lab - 2	--	04	--	03	40	60	100	2
7	PCC	20 MST27	Technical Seminar	--	02	--	--	100	--	100	2
TOTAL				**17**	**06**	**06**	**18**	**340**	**360**	**700**	**24**

Note: PCC: Professional core, PEC: Professional Elective.

Professional Elective 1		**Professional Elective 2**	
Course Code under 20XXX24X	**Course title**	**Course Code under 20XXX25X**	**Course title**
20 MST241	Surface Treatment & finishing	20 MST251	Modelling, Simulation & Analysis of Manufacturing Systems
20 MST242	Agile Manufacturing	20 MST252	Bio Materials & Technology
20 MST243	Advanced Moulding Techniques	**20 MST253**	**Mechanical Behaviour of Materials**
20 MST244	Advances in Materials and Processing	20 MST254	Non – Destructive Testing

Note:

1. Technical Seminar: 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. Participation in the seminar by all postgraduate students of the same and other semesters of the programme shall be mandatory.

The CIE marks awarded for Technical Seminar, shall be based on the evaluation of Seminar Report, Presentation skill and Question and Answer session in the ratio 50:25:25.

2. Internship: All the students shall have to undergo mandatory internship of 6 weeks during the vacation of I and II semesters and /or II and III semesters. A University examination shall be conducted during III semester and the prescribed credit shall be counted in the same semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail in internship course and have to complete the same during the subsequent University examination after satisfying the internship requirements.

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III SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week			Examination				Credits
				Theory	Practical/ Mini –Project/ Internship	Skill Development activities (SDA)	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	20 MST31	Plastic Processing	03	--	02	03	40	60	100	4
2	PEC	20 MST32X	Professional elective 3	03	--	--	03	40	60	100	3
3	PEC	20 MST33X	Professional elective 4	03	--	--	03	40	60	100	3
4	Project	20 MST34	Project Work phase -1	--	02	--	--	100	--	100	2
5	PCC	20 MST35	Mini-Project	--	02	--	--	100	--	100	2
6	Internship	20 MSTI36	Internship	(Completed during the intervening vacation of I and II semesters and /or II and III semesters.)			03	40	60	100	6
TOTAL				**09**	**04**	**02**	**12**	**360**	**240**	**600**	**20**

Note: PCC: Professional core, PEC: Professional Elective.

Professional elective 3		**Professional elective 4**	
Course Code under 20XXX32X	**Course title**	**Course Code under 20XXX33X**	**Course title**
20 MST321	**Experimental Methods in engineering**	20 MST331	**Electronic, Optical and Magnetic Properties of Materials**
20 MST322	**Manufacturing of Electronic Components**	20 MST332	**Particulate Technology**
20 MST323	**Non-Traditional Machining**	20 MST333	**Corrosion Science And Technology**
20 MST324	**Vacuum Science & Cryogenics**	20 MST334	**Reliability Engineering**

Note:

1. Project Phase-1: Students in consultation with the guide/co-guide if any, shall pursue literature survey and complete the preliminary requirements of selected Project work. Each student shall prepare relevant introductory project document, and present a seminar.

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. The CIE marks awarded for project work phase -1, shall be based on the evaluation of Project Report, Project Presentation skill and Question and Answer session in the ratio 50:25:25.

SEE (University examination) shall be as per the University norms.

2. Internship: Those, who have not pursued /completed the internship shall be declared as fail in internship course and have to complete the same during subsequent University examinations after satisfying the internship requirements. Internship SEE (University examination) shall be as per the University norms.

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IV SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week		Examination				Credits
				Theory	Practical/ Field work	Duration in hours	CIE Marks	SEE Marks Viva voce	Total Marks	
1	Project	20 MST41	Project work phase -2	--	04	03	40	60	100	20
			TOTAL	--	**04**	**03**	**40**	**60**	**100**	**20**

Note:

1. Project Phase-2:

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. The CIE marks awarded for project work phase -2, shall be based on the evaluation of Project Report subjected to plagiarism check, Project Presentation skill and Question and Answer session in the ratio 50:25:25.

SEE shall be at the end of IV semester. Project work evaluation and Viva-Voce examination (SEE), after satisfying the plagiarism check, shall be as per the University norms.

APPLIED MATHEMATICS			
Course Code	20MST11	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Approximations and round off errors: Significant figures, accuracy and precision, error definitions, round off errors and truncation errors. Mathematical modelling and Engineering problem solving: Simple mathematical model, Conservation Laws of Engineering. Exercises to be given for solving in software tools

Module-2

Roots of Equations: Bracketing Methods-Graphical method, Bisection method, False position method, Newton-Raphson method, Secant Method. Multiple roots, Simple fixed-point iteration. Roots of polynomial-Polynomials in Engineering and Science, Muller's method, Bairstow's Method Graeffe's Roots Squaring Method.

Exercises to be given for solving in software tools

Module-3

Numerical Differentiation and Numerical Integration: Newton –Cotes and Guass Quadrature Integration formulae, Integration of Equations, Romberg integration, Numerical Differentiation Applied to Engineering problems, High Accuracy differentiation formulae. Exercises to be given for solving in software tools.

Module-4

System of Linear Algebraic Equations and Eigen Value Problems: Introduction, Direct methods, Cramer's Rule, Gauss Elimination Method, Gauss-Jordan Elimination Method, Triangularization method, Cholesky Method, Partition method, error Analysis for direct methods, Iteration Methods. Eigen values and Eigen Vectors: Bounds on Eigen Values, Jacobi method for symmetric matrices, Givens method for symmetric matrices, Householder's method for symmetric matrices, Rutishauser method for arbitrary matrices, Power method, Inverse power method. Exercises to be given for solving in software tools

Module-5

Linear Transformation: Introduction to Linear Transformation, The matrix of Linear Transformation, Linear Models in Science and Engineering Orthogonality and Least Squares: Inner product, length and orthogonality, orthogonal sets, Orthogonal projections, The Gram-Schmidt process, Least Square problems, Inner product spaces.

Exercises to be given for solving in software tools

Course outcomes:

At the end of the course the student will be able to:

1) Model some simple mathematical models of physical Applications.
2) Find the roots of polynomials in Science and Engineering problems.
3) Differentiate and integrate a function for a given set of tabulated data, for Engineering Applications**.**
4. Knowledge of usage of software tools like Mathematica, CILab, Matlab etc.,
5. Application of software for problem solving.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks
1. S.S. Sastry, Introductory Methods of Numerical Analysis, PHI, 2005.
2. Steven C. Chapra, Raymond P. Canale, Numerical Methods for Engineers, Tata McGraw Hill, 4th Ed, 2002.
Reference Books
1. Pervez Moin, Fundamentals of Engineering Numerical Analysis, Cambridge, 2010.
2. David. C. Lay, Linear Algebra and its applications, 3rd edition, Pearson Education, 2002
.

COMPUTATIONAL TECHNIQUES			
Course Code	20MST12	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Design of Experiments: Factorial Design, Taguchi Techniques, ANOVA

Module-2

Artificial Intelligence: ANN, fuzzy Logic, Genetic Algorithm, Applications in Materials Engg.,

Module-3

Optimization Methods: Classical optimization methods, unconstrained minimization. Univariate, conjugate direction, gradient and variable metric methods, constrained minimization, feasible direction and projections. Integer and geometric programming

Module-4

Numerical Fluid Flow and Heat Transfer: Classification of PDE, Finite differences, Steady and unsteady conduction, explicit and implicit method.

Module-5

Finite element Methods: Introduction to I-D FEM; Problems in structural Mechanics using 2D elements, Plane stress, plain strain, axisymmetric analysis; three-dimensional analysis.

Course outcomes:

At the end of the course the student will be able to:

- Students will be in a position to Understand & Identify Techniques of Optimisation for real industry problems.
- Apply techniques to real time problems.
- Apply AI techniques in Material Engineering.
- Develop skill to solve simple beam problems using the steps of FEM
- Formulate element properties of 1D & 2D elements.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

1. Design and analysis of experiments - Douglas C. Montgomery, 5th ed., John Wiley and Sons, 2001

2. Introduction to Finite Elements in Engineering - Tirupathi R. Chandrupatla and Ashok D. Belegundu, 2nd Ed., Prentice-Hall, 1997

Reference Books

3. Artificial Neural Networks - B. Yegnanarayana, Prentice-Hall of India, 1999

4. Taguchi techniques for quality engineering - Phillip J. Ross, McGraw-Hill Book company, 1996

5. Numerical heat transfer and fluid flow- Suhas V. Patankar, Hemisphere Publishing Corporation, 1980

MATERIALS FOR CRYOGENIC AND HIGH TEMPRATURE APPLICATIONS			
Course Code	20MST13	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction: Historical Background – Introduction to Cryogenic propellants –Liquid hydrogen, Liquid helium, Liquid nitrogen and Liquid oxygen and their properties. Production of low Temperature: Theory behind the production of low temperature –Expansion engine heat exchangers – Cascade process Joule Thompson Effect –Magnetic effect – Ortho and Para H2 – Helium4 and Helium3.

Module-2

Efficiency of Cryogenic Systems: Types of losses and efficiency cycles –Specific amount of cooling – The fraction liquefied – Cooling coefficient of performance Thermodynamic efficiency – The energy balance Methods. Cycles Of Cryogenic Plant: Classification of cryogenic cycles – The structure of cycle –Throttle expansion cycles – Expander cycles – Thermodynamic analysis – Numerical problem s.

Module-3

Cryogenic Fluid Storage And Transfer Systems: Basic storage vessels, insulations, un insulated and porous insulated lines, vacuum insulated lines, cryogenic valves, cool down process. Measurement Systems for Low Temperatures: Introduction, Temperature scales and fixed points, Metallic resistance thermometers, thermo couples, constant volume gas thermometers, magnetic thermometers, vapour pressure thermometers.

Module-4

Vacuum Technology: Importance flow regimes in vacuum system, components of vacuum system, mechanical vacuum pumps, diffusion pumps, vacuum gauges and valves.

Module-5

Cryogenic In Automotive and Aerospace Applications: Cryogenic liquids in missile launching and space simulation – storage of cryogen in liquids- Effect of cryogenic liquids on properties of Aerospace materials – Cryogenic loading problems – Zero gravity problems associated with cryogenic propellants – Phenomenon of tank collapse – Elimination of Geysering effect in missiles.

Course outcomes:

At the end of the course the student will be able to:

- Analyse the properties of material at low temperature. Pressure, temperature, flow,fluid quality and liquid level measurement at low temperature. (PO-2).
- Have Knowledge of Cryogenic systems.
- Acquire knowledge of low temperature measurements.
- Have knowledge of vacuum technology
- Apply knowledge of cryogenics in practical situations.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Cryogenics, Theory, Processes & Applications by Allyson E Hayes, Nova Publications -2013

. Cryogenic Systems, Barron, Oxford University, 1985.

Reference Books
1. Cryogenic Fundamentals, Haseldom.G. Academic Press, 1971.
2. Propellant Chemistry, Parner S.F. Reinhold publishing Corpn., New York 1985.
3. Mechanical Properties of Materials at Low Temperatures, Wigley D.A. (1971) Plenum Press, New

NANOSCIENCE AND NANOMATERIALS			
Course Code	20MST14	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction To Nanoscience And Nanotechnology: History, background scope and interdisciplinary nature of nanoscience and nanotechnology, scientific revolutions, nano sized effects surface to volume ratio, atomic structure, molecules and phases, energy at the nanoscale molecular and atomic size, quantum effects, types of nanotechnology and nanomachines. Classification Of Nanostructures: Zero dimensional, one-dimensional and two dimensional nanostructure materials-clusters of metals, semiconductors, ceramics and nano composites, size dependent phenomena, quantum dots nano wires, tubes, nano sheets, nano and mespores, top down and bottom ups approach, misnomers and misconception of nano technology, importance of nanoscale materials and their devices.

Module-2

Properties Of Nanomaterials: Mechanical properties-Thermo physical properties -Electrical properties Electric properties – Electro chemical properties Magnetic properties -optical properties-Catalytic property – properties of gas permeation and separation membranes. Nanostructure Design: Functionality of nanostructures and their characteristics evaluation, size effect in semiconductor nanoparticles– particle size, shape density – Melting point, surface tension, wettability – specific surface area and pore – Assembly of nanoparticles and fictionalization – nanoparticles arranged structures as nanopores and nanocomposites –Structure control of nanoparticle collectives by sintering and bounding – Self – assembly. Nanoparticle dispersion and aggression behaviour – Single nanoparticle motion in fluid –Brownian diffusion – Adsorption properties – interactions between particles – Aggregation and dispersion, characterization and control – Rheology of slurry – Simulation of colloidal dispersion system

Module-3

Melting Point And Phase Transition Processes: quantum-size-effect (QSE) Size-induced metal-insulator-transition (SIMIT) nano-scale magnets, transparent magnetic materials and ultrahigh-density magnetic recording materials – chemical physical of atomic and molecular clusters. Surface energy – chemical potential as a function of surface curvature – Electrostatic stabilization – surface charge density-electric potential at the proximity of solid surface-Vander Waals attraction potential. Photochemistry, Photoconductivity, Electrochemistry of nanomaterials – Diffusion in Nanomaterials, Nanoscale Heat transfer, Catalysis by Gold. Nanoparticles, Transport in semiconductor Nanostructures, Transition Metal Atoms on Nanocarbon Surfaces, Nano deposition of soft materials, Nano catalysis. Surface Modification Of Nanoparticles: Surface modification of inorganic nanoparticles by organic functional groups Instantaneous nano foaming method for fabrication of closed –porosity silica particle- Development of photo catalyst inserted into surface of porous alumina silicate-Fabrication technique of organic nano crystals and their optical properties and materialization, Dispersion control of nanoparticles in solvents – Development of new cosmetics based on nanoparticles – Development of functional skincare cosmetics using biodegradable PLGA nano spheres.

Module-4

Application Of Quantum Dots For Bio-Medical Engineering: Bio- imaging with quantum dots – Pinpoint drug and gene delivery- delivery to the brain – Development of the thermo responsive magnetic nanoparticle and its deployment in the biotechnology field, Addressing of nanoparticles by using DNA molecules, Nanoparticle formation of DNA (globule transformation) – Development and multi-functionalization of high – functional separation membranes – Design of nanoparticles for oral delivery of peptide drugs.

Module-5

Smart Materials And Systems: Thermo responsive materials, piezoelectric materials, electro strictive and magneto strictive materials, ferrofluids, ER and MR fluids, biomimetic materials, smart gel, shape memory alloys and polymers, actuation methods, measurements.

Course outcomes:

At the end of the course the student will be able to:

1. Demonstrate the working knowledge of nanotechnology principles and industry applications. (PO-2)
2. Design the nanoscale paradigm in terms of properties at the nanoscale dimension. (PO-2)
3. Apply key concepts in materials science, chemistry, physics, biology and engineering to the field of nanotechnology. (PO-2)
4. Identify current nanotechnology solutions in design, engineering and manufacturing. (PO-3)
5. Explain chemical reactivity on the basis of structure and electronic arrangements. (PO-2) Understand and interpret the melting point and phase transition of nano materials. (PO-1,4)

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

1.. "Nanophysics and Nanotechnology" – An Introduction to ModernConcepts in Nanoscience, Edward L. Wolf Second Edition, John Wile y & Sons, 2006.
2. Nano: The essentials, Pradeep, T, McGraw Hill.
3. Introduction to Nano Technology, Poole, C.P and Owens, J.F, Wiley

1. "Surface Science Foundation of Catalysis and Nanoscience ", K.W. Kolasinski –Wiley, 2002
2. Nano particles: From theory to applications, Schmid, G., Wiley VCH Verlag GmBH and Co

Reference Books

1. Nanoparticulate as Drug Carriers, Valdimir P, Torchilin (2006) imperial college press.

2. Nanomaterials and Nano systems for Bio-Medical Applications, M Reza Mozafari (2007) springer.

3. Nanotechnology – Basic science and emerging technologies Chapman and Hall/CRC (2002).

4. Nanomaterials and Nanotechnologies and design on introduction for engineers and architects, Micheal F.

MECHANICAL BEHAVIOUR OF THIN FILMS			
Course Code	20MST15	CIE Marks	40
Teaching Hours/Week (L:P: SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Vacuum components and systems: Need for vacuum, ways to achieve vacuum, determination of vacuum, dry and vapour pumps, pressure measurement gauges, conductance and other system design considerations.

Module-2

Thin film deposition techniques: Physical and chemical vapour deposition techniques including molecular beam epitaxy, laser ablation and hot wire and microwave CVD techniques. Film contamination, cosine law of deposition, conformal coverge and line of sight deposition.

Module-3

Growth of thin films: Thermodynamic and kinetic considerations of deposition of thin films by both CVD and PVD. In situ characterization of thin film deposition process**.**

Module-4

Characterization of thin films: Different methods of thickness measurements, electrical, optical, chemical and structural property determination

Module-5

Some important applications of thin films: Hard and decorative coatings, semiconductor thin films, organic thin films.

Course outcomes:

At the end of the course the student will be able to:

- Students will be in a position to understand the science of thin films.
- Understanding of vacuum technology
- Knowledge of deposition techniques.
- Understanding of characterization techniques of thin film deposition.
- Apply knowledge to practical applications.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

Materials science of thin films, M. Ohring, Academic press, 2006

2. Vacuum deposition of thin films, L. Holland, Chapman and Hall.

Reference Books

3. Glow discharge processes, B. Chapman, Wiley, New York.
4. Thin film phenomena, K. Chopra, McGraw Hill, Yew York.
5. Thin film materials: stress, defect formation and surface evolution. L. B. Freund, S. Suresh
6.Thin Film Deposition; Principles and practices by Denald L. Smith, McGraw Hill.
7. Principles of Chemical Vapor Deposition by D. M. Dolokin, M.K. Zwrow, Kluwer Academic Publisher.
8.Chemical Vapor Deposition by Pradeep George, VDM Verles Dr. Mueller E.K.

MATERIAL CHARACTERIZATION LAB – 1			
Course Code	20MSTL16	CIE Marks	40
Teaching Hours/Week (L:P: SDA)	0:4:0	SEE Marks	60
Credits	02	Exam Hours	03

Sl. NO	Experiments
1.	Powder characterization using XRD, SEM and BET, gas pycnometer
2.	Thermal properties of materials, identification of materials based on their TG, DSC, DMA characteristic responses
3.	Laboratory testing practice related to tests based on the mechanical properties of materials, e.g., hardness, elastic modulus, tensile strength etc.
4.	hands-on experience on the applications of metallography and optical microscopy, phase analysis using microscopic information,
5.	hands-on experience in the area of microstructures of metal, ceramic and polymer materials using optical microscopy and SEM.
6.	Phase identification using X-ray Diffraction
7.	Study the effect of quenching media on microstructure and hardness of high-speed steels.
8.	Establish relationship between hardness and microstructure of forged/rolled/extruded popular aerospace / light alloys.
9.	Observation of specimens in TEM.

Any 5 experiments can be done.

RESEARCH METHODOLOGY AND IPR			
Course Code	20RMI17	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	1:0:2	SEE Marks	60
Credits	02	Exam Hours	03

Module-1

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and Problems Encountered by Researchers in India.

Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration. ■

Module-2

Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.

Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs. ■

Module-3

Design of Sampling: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs.

Measurement and Scaling: Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement Tools, Scaling, Scale Classification Bases, Scaling Technics, Multidimensional Scaling, Deciding the Scale.

Data Collection: Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method. ■

Module-4

Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis.

Chi-square Test: Test of Difference of more than Two Proportions, Test of Independence of Attributes, Test of Goodness of Fit, Cautions in Using Chi Square Tests. ■

Module-5

Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.

Intellectual Property: The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999,The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957,The Protection of Plant Varieties and Farmers' Rights Act, 2001,The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity, The Convention on Biological Diversity (CBD) 1992, Competing Rationales for Protection of IPRs, Leading International Instruments Concerning IPR, World Intellectual Property Organisation (WIPO),WIPO and WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules, Patents, Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition, Patent Cooperation Treaty (PCT), Advantages of PCT Filing, Berne Convention for the Protection of Literary and Artistic Works, Basic Principles, Duration of Protection, Trade Related Aspects of Intellectual Property Rights(TRIPS) Agreement, Covered under TRIPS Agreement, Features of the Agreement, Protection of Intellectual Property under TRIPS, Copyright and Related Rights, Trademarks, Geographical indications, Industrial Designs, Patents, Patentable Subject Matter,

Rights Conferred, Exceptions, Term of protection, Conditions on Patent Applicants, Process Patents, Other Use without Authorization of the Right Holder, Layout-Designs of Integrated Circuits, Protection of Undisclosed Information, Enforcement of Intellectual Property Rights, UNSECO.

Course outcomes:

At the end of the course the student will be able to:

- Discuss research methodology and the technique of defining a research problem
- Explain the functions of the literature review in research, carrying out a literature search, developing theoretical and conceptual frameworks and writing a review.
- Explain various research designs, sampling designs, measurement and scaling techniques and also different methods of data collections.
- Explain several parametric tests of hypotheses, Chi-square test, art of interpretation and writing research reports
- Discuss various forms of the intellectual property, its relevance and business impact in the changing global business environment and leading International Instruments concerning IPR. ■

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbooks

(1) Research Methodology: Methods and Techniques, C.R. Kothari, Gaurav Garg,New Age International,4th Edition, 2018.

(2) Research Methodology a step-by-step guide for beginners. (For the topic Reviewing the literature under module 2), RanjitKumar,SAGE Publications,3rd Edition, 2011.

(3) Study Material (For the topic Intellectual Property under module 5),
Professional Programme Intellectual Property Rights, Law and Practice, The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament, September 2013.

Reference Books

(1) Research Methods: the concise knowledge base, Trochim, Atomic Dog Publishing, 2005.

(2) Conducting Research Literature Reviews: From the Internet to Paper, Fink A, Sage Publications, 2009.

*** END OF I SEMESTER ***

SMART MATERIALS AND STRUCTURES			
Course Code	20MST21	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Smart Structures: Types of Smart Structures, Potential Feasibility of Smart Structures, Key Elements Of Smart Structures, Applications of Smart Structures. Piezoelectric materials, Properties, piezoelectric Constitutive Relations, Depoling and Coercive Field, field strain relation. Hysteresis, Creep and Strain Rate effects, Inchworm Linear Motor. Beam Modelling: Beam Modelling with induced strain Rate effects, Inchworm Linear Motor Beam Modelling with induced strain Actuation-single Actuators, dual Actuators, Pure Extension, Pure Bending harmonic excitation, Bernoulli-Euler beam Model, problems, Piezoelectrical Applications.

Module-2

Shape memory Alloy: Experimental Phenomenology, Shape Memory Effect, Phase Transformation, Tanaka's Constitutive Model, testing of SMA Wires, Vibration Control through SMA, Multiplexing. Applications Of SMA and Problems. ER and MR Fluids: Mechanisms and properties, Fluid Composition and behavior, The Bingham Plastic and Related Models, Pre-Yield Response. Post-Yield flow applications in Clatches, Dampers and Others.

Module-3

Vibration Absorbers: series and Parallel Damped Vibrations (Over View), Active Vibration Absorbers, Fiber Optics, Physical Phenomena, Characteristics, Sensors, Fiber Optics in Crack Detection, applications. Control of Structures: Modelling, Control Strategies and Limitations, Active Structures in Practice. 10Hours

Module-4

MEMS – Mechanical Properties of MEMS Materials, Scaling of Mechanical Systems, Fundamentals of Theory, The Intrinsic Characteristics of MEMS, Miniaturization, Microelectronics Integration.

Module-5

Devices: Sensors and Actuators, Conductivity of Semiconductors, Crystal Planes and Orientation, (Stress and Strain Relations, Flexural Beam Bending Analysis Under Simple Loading Conditions), Polymers in MEMS, Optical MEMS Applications.

Course outcomes:

At the end of the course the student will be able to:

1) Understand the behaviour and applicability of various smart materials
2) Design simple models for smart structures & materials
3) Perform simulations of smart structures & materials application
4) Conduct experiments to verify the predictions
5) knowledge of sensors, actuators.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.■

Textbook/ Textbooks

1. Smart Materials and Structures - M. V. Gandhi and B. So Thompson, Chapman and Hall, London; New York, 1992 (ISBN: 0412370107).
2. Smart Structures and Materials - B. Culshaw, Artech House, Boston, 1996 (ISBN :0890066817).
3. Smart Structures: Analysis and Design - A. V. Srinivasan, Cambridge University Press, Cambridge; New York, 2001 (ISBN: 0521650267).

Reference Books

1. Electro ceramics: Materials, Properties and Applications - A. J. Moulson and J. M. Herbert. John Wiley & Sons, ISBN: 0471497429
2. Piezoelectric Sensories: Force, Strain, Pressure, Acceleration and Acoustic Emission Sensors. Materials and Amplifiers, Springer, Berlin; New York, 2002 (ISBN: 3540422595).
3. Piezoelectric Actuators and Wtrasonic Motors - K. Uchino, Kluwer Academic Publishers, Boston, 1997 (ISBN: 0792398114).
4. Handbook of Giant Magneto strictive Materials - G. Engdahl, Academic Press, San Diego, Calif.; London, 2000 (ISBN: 012238640X).
5. Shape Memory Materials - K. Otsuka and C. M. Wayman, Cambridge University Press, Cambridge; New York, 199~ (ISBN: 052144487X).

TESTING OF MATERIALS			
Course Code	20MST22	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Testing machines and sensors: types of Universal Testing machines and principles of operations, Machine stiffness, load and strain measurement. Calibration and verification of UTM. Friction, wear and surface testing: Testing of sliding contact, damage, abrasive wear, adhesive wear, erosive wear. Testing and determination of surface characteristics of solid materials. (Surface roughness measurements) 10Hours

Module-2

Importance of calibration of Testing Instruments: Calibration methods and standards. Tests/ experiments based on methods with active reference to various codes and standard for each test.Failure Analysis: Principles and Approaches of Failure analysis, objectives, scope, planning ,preparation. Failure Analysis procedures. examination of damages and materials evaluation. Tools and Techniques in FA – An overview. Appearances of fracture in common conditions like unit axial loads, tensional and shear loads, fatigue and creep loading.

Module-3

Microscopy: Optical microscope, scanning electron microscope. Preparation of Specimens for microscopic study. Speed & Control of Testing Background Developments in testing Machine Technology, Effects of testing rates on properties Results before servo control, Results from servo controlled machines.

Module-4

Strain Rate Testing Aim of Recommendations, Abbreviations and Symbols, Test Machine Requirement, Specimens Measurements, Data Processing, General Definitions Strength Hardening Constitutive Relations to Model Material Strain Rate Dependency

Module-5

Lubrication & Determination of characteristics of lubricants: Introduction, Types of lubricants, characteristics of lubricants Methods of lubrication, four ball testing.

Course outcomes:

At the end of the course the student will be able to:

- Students will be able to understand and correlate various testing methods used in industries.
- Understanding of various testing methods for practical applications.
- Use various types of microscopic studies.
- Knowledge of data processing and correlating them
- Apply lubricating techniques and testing them.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

1. Testing of Metallic Materials – A.V.K. Suryanarayana, Prentice Hall of India. 2007

Reference Books

1. ASM Vol Testing of materials
2. Inspection of Materials, Vol. II – Destructive Methods, R.C. Andersen, ASM 1988.
3. Workability Testing Techniques, G.E. Dieter, ASM 1984.
4. Relevant codes and standards.

ADVANCED FOUNDRY TECHNOLOGY			
Course Code	20MST23	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Solidification of Casting: Concept of solidification of metals. Homogenous and heterogeneous nucleation. Growth mechanism. Solidification of pure metals and alloys. Mechanism of columnar and dendritic growth. Coring or Segregation. Solidification time and Chvorinov's rule. Concept of progressive and directional solidifications. Principles of Gating and Risering: Purpose of the gating system. Components of the gating System and its functions. Design of the gating System. Different types of gates. Gating ratio and its functions. Definition and functions of the riser. Types of risers and their application. Design of the riser - its shape. Size and location. Use of insulating material and exothermic compounds in risers.

Module-2

Design of Casting and Quality Control: Factors to be considered in casting design. Design consideration in pattern making, moulding techniques and core making and assembly. Cooling stresses and hot spots in casting and modification in casting geometry to overcome them. Casting defects and factors responsible for them. Different inspection and testing methods to evaluate the casting. Quality control activities in a foundry. Salvaging methods of defective casting. Furnace Technology: Study of various furnaces used in foundry, construction and operation of crucible and hearth furnaces. Resistance, Arc and Induction furnaces-their construction. Operation and application. Heat treatment furnaces and drying ovens used in foundry.

Module-3

Special casting processes: Investment casting, Die casting, centrifugal casting, full mould casting, vacuum shield casting etc.
Industrial melting practices: Aim of melting and melting practices as adopted in case of Cast Irons, Steel, Cu, Al and its alloys.

Module-4

Aluminium Foundry Practice:. Copper Alloy Foundry Practice: General characteristics of common cast copper alloys. Melting and casting of copper alloys. Gating and risering of cu-alloy castings.

Module-5

Foundry Mechanization and Modernization: Introduction to modernization. Mechanization of foundry and its advantages. Mechanization of sand plant, moulding and core making mechanization in melting, pouring and shakeout units. Material handling equipment's and conveyor systems. Brief sketches and description of layouts of job. Captive and mechanized foundries.

Course outcomes:

At the end of the course the student will be able to:

1. To promote understanding of basic facts and concepts in foundry process while retaining the excitement of foundry industry. (PO-1)
2. Understand and apply the studies of different processes used in Foundry Industries and their applications. (PO-1, 2)
3. Acquire the skill and knowledge of terms, facts, concepts, processes, techniques and principles of foundry industries. (PO-2,3)
4. Apply the skill and knowledge of contents of principles of furnace technology. (PO-1,2)
5. Inquire of new skill and knowledge of foundry practises and developments therein. (PO-2,5)
6. Expose and to develop interest in the fields of design of casting. (PO-3,4,7)

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks 1. A Test Book of Foundry Technology - Lal, M. Khanna, P.O – Dhanpat Rai & Sons Publication. 2011 2. Advanced Foundry Technology – Pranav Pandey Pdf - 2017
Reference Books 1. Principle of Metal Casting - Heine, et. al - Tata-McGraw-HiII Publication - 2003. 2. Foundry Technology - Beelely, P.R. – Butterworth & Co. 3. Fundamentals of Foundry Technology, Webster, P.D., 4. Fundamentals of Metal casting Technology, Mukherjee, P.C

SURFACE TREATMENT AND FINISHING			
Course Code	20MST241	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Fundamentals of Electro plating, galvanizing, Hot dip metal coating, thin coating, thin coating, chromium plating, Nickel plating. Vacuum coating, FVD & CVD metal spraying - Methods, surface preparation, mechanical.

Module-2

Properties of sprayed metals, Various types and plasma coating. Plastic coating of metal - PVC coating Spherodising process details, phosphate coating - mechanism of formation.

Module-3

Testing of surface coating- Various methods used. Heat treatment methods, Annealing, Normalizing, Tempering, Case hardening methods, flame hardening sub-zero treatment.

Module-4

Heat treatment methods for gears, spindles, cutting tools.

Module-5

Advanced coating technologies: Hard facing, electro deposition technique, nanocoating's, coating characterization.

Course outcomes:

At the end of the course the student will be able to:

- Students will be able gain knowledge in surface treatment, electroplating, surface coating and heat treatment techniques.
- Understand the properties of coatings
- Apply knowledge of testing in surface coating
- Gain knowledge of various heat treatment methods used in industry
- Apply knowledge of advanced technologies in coating industry.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

1. Surface preparations & finishes for Metals - James A Murphy - McGraw Hill.
2. Hand book, Friction, Lubrication and Wear Technology, Vol. 18, ASM .
3. Surface treatments for protection, Series3, No. 10, , The institute of metallurgist series.

Reference Books

1. Principles of metal surface treatment and protection - Pergamon Press Gabe, David Russell - Description, Oxford; New York - 2d ed., 1978.
2. Handbook of metal treatment and testing - John wiley & sons.
3. Heat Treatment of Metals – Zakrov - MlR Publications.
4. Metals Hand Book – ASM.

AGILE MANUFACTURING			
Course Code	20MST242	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Agile Manufacturing: Definition, business need, conceptual frame work, characteristics, generic features. Four Core concepts: Strategy driven approach integrating organization, people technology, interdisciplinary design methodology.

Module-2

Developing Agile Manufacturing: Enterprise design, System concepts as the basic manufacturing theory-joint technical & Organizational design and a model for the design of agile manufacturing enterprise. Enterprise design process insights into design processes, what is interdisciplinary design, main issues, simple design example. Integration of Product /Process Development: Principles, Robust design approach, Approaches to enhance ability in manufacturing, Role of QFD, Managing people in Agile organization, Approaches.

Module-3

Application of IT/IS Concepts In Agile Manufacturing: Strategies, Management of complexities and information. flow, approaches, applications of multimedia to improve agility in manufacturing, system concepts. Agile Supply Chain Management: Principles, IT/IS concepts in supply chain management, enterprise integration and management in agile manufacturing, concepts, Agility, Adaptability and learners – comparison of concept

Module-4

Computer Control Of Agile Manufacturing: CAPP for Agile Manufacturing, Aggregate capacity planning and production line design / redesign in Agile manufacturing, Cellular manufacturing, concepts, examples. Corporate Knowledge Management In Agile Manufacturing: Strategies, strategic options in Agile manufacturing, Role of standards.

Module-5

Design of Skill & Knowledge: Enhancing technology for Machine tool system, Resumption of design requirement geometry, definition, methods, decision support for selection of cutting parameters, design enhancements, parametric approach only.

Course outcomes:

At the end of the course the student will be able to:

1. Understand conceptual frame work of agile manufacturing environment.
2. Get insight into Enterprise design process, apply interdisciplinary design concepts.
3. Develop characteristic difference between lean manufacturing and agile manufacturing and appreciate benefits that can be derived by adopting newer manufacturing strategies.
4. Develop skill & Knowledge for machining tool system.
5. learn concepts of SCM.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

1. 'Agile Manufacturing - Forging Mew Frontiers', Poul T Kidd, Amagow Co. UK, ISBN-0-201-63163-6, 1994.
2. ''Agile Manufacturing", A Gunasekaran, the 21 Century Competitive strategy, ISBN -13 978-0-08-04 3567-1, Elsevier Press, India. 2001.

Reference Books

1. O Levine Transitions to Agile Manufacturing, Joseph C Moutigomery and Lawrence – Staying Flexibl e for competitive advant age, ASQC quality press, Milwaukee. Wisconsin, USA, 1996.
2. Agile Development for Mass Customization, David M Anderson and B Joseph Pine, Irwin Professional Publishing, Chicago, USA, 1997.

ADVANCED MOULDING TECHNIQUES			
Course Code	20MST243	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Injection Moulding Technology: Microprocessor control injection moulding machine, close loop control, open loop control, CNC control, multi color injection moulding, rotary injection moulding, structural foam moulding, sandwich injection moulding. Metal injection moulding: contact injection moulding, moulding of cellular product like EPS, steam chest moulding, future trends in injection moulding like external & internal inter locking alignment of large moulds, processing of specialty polymers.

Module-2

Extrusion: General consideration during extrusion process like specific heat, latent heat, internal conductivity, shape & size of granular hygroscopic nature over temperature, effect of flow property like relaxation time & defects like shark skin, elastic turbulence, influence of TG, TM & crystal growth rate, cooling rate, impact strength, manufacturing of woven sacks etc. co extrusion, co extruded pipe, multi-layer pipe, foam pipe, biaxial oriented pipe.

Module-3

Lamination: Lamination by extrusion coating, twin screw extrusion, co-rotating & counter rotating, feeding mechanism in twin screw extruder, roll of side feeder & injection feeder, principles of compounding, mixing mechanism etc.

Module-4

Blow Moulding: Microprocessor / CNC controlled blow moulding machine, injection stretch blow moulding of PET, pre-cut moulding, multi-layer blow moulding, Parisian programming. Reaction Injection Moulding (RIM): RIM of Polyurethane, material for RIM, liquid RIM and its advantages over conventional injection moulding, RRIM.

Module-5

PTFE Moulding: Processing techniques used for PTFE, Material consideration, sintering, Ram extrusion, and Paste extrusion, lso statistic. Moulding and skewing technique for PTFE processing. Advancement in Other Processing Technique: New techniques like Resin transfer moulding, Pultrusion. Filament winding, multi layer rotation moulding, Electro plating and printings, Centrifugal casting, Shrink film, Clink film.

Course outcomes:

At the end of the course the student will be able to:

- Students will be able to demonstrate their knowledge in the field of advanced moulding methods.
- Thorough knowledge of Extrusion process.
- Apply knowledge in mold industry
- Demonstrate skills in various molding technique.
- Learn newer techniques in molding technology.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

Advanced Moulding Techniques by Shia-Chung Chen and Lih-Sheng Turng, Hanser Publications, 2016. ISBN978-1-56990-603-3

1. Injection Moulding, Rubin.
2. Extrusion –Berln.

Reference Books

1. Extrusion Die Design, M. V. Joshi.
2. Polymer Chemistry, Gowriker

ADVANCED MATERIALS AND PROCESSING			
Course Code	20 MST 244	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Classification and Characteristics: Metals, Nonferrous Metals and Ferrous Metals, classification of Ferrous Metals and Non-Ferrous Metals, Types of Ceramics, Polymers and composites and classification of composites. General Properties and Structure: Atoms, molecules bonds in solids, Crystalline – Defects in Metallic structure, Dislocations and plastic deformation - Strengthening mechanism – grain size, dislocation - Cold work, precipitation hardening, dispersion hardening - phase reactions, fatigue and Creep behaviour.

Module-2

Ferrous Alloys: iron carbon equilibrium diagrams - Steels and cast irons - properties, structure, composition and applications transformation hardening in steels - TIT diagrams - Heat treatment processes - Effect of alloying elements - High alloy steels, Stainless steel types, tool Steels, Manganese steels, heat resistant steels, HSLA, Managing steels. Non-Ferrous Alloys: Alloys of copper, Aluminium, nickel, magnesium, titanium, lead, tin, Zinc - composition, heat treatment, structure, properties and application.

Module-3

Polymers and Polymerizations: Structure and properties of thermoplastics and thermosets – Engineering Applications - property modifications - Mechanical and thermal behaviour – processing methods Ceramics: Nature and structure of Ceramics - Refractory Abrasives glasses - glass ceramics - Advanced ceramics processing methods.

Module-4

Composites: Definition - classification and characteristics of composite materials - Volume fraction - laminated composites particulate composites, fibrous composites – Types of reinforcements, their shape and size - production and properties of fiber reinforced plastics, Metal Matrix composites and ceramic matrix composites - Applications.

Module-5

Processing of Polymers: composites, ceramics - thermal spraying - Ion beam machining diamond coating techniques-tribological applications.

Course outcomes:

At the end of the course the student will be able to:

1. Understand and apply the various processing and manufacturing techniques. (PO-5)
2. Knowledge of basics of process and important parameters of equipment design. (PO-3)
3. Understand and apply the techniques and their characteristics/limitations of synthesis of polymers. (PO-1,5)
4. Understand the structure-processing-property relationship of metals and polymers. (PO-3)
5. Understand the basic issues involved in polymer blends, metal matrix composites and ceramic matrix composites. (PO-2)
6. Understand the significance of alloying element and phase diagrams. (PO-3,4)

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

Advanced Materials and Processes - James W. Evans Lutgard C. De Jonghe. Springer Publications – 2016.

1. Engineering Metallurgy - Raymond and Higgens - ELBS/EA
2. Introduction to Material Science and Engineering James. F. Shackleford - Mc Millan, NY - 7th edition.

Reference Books

1. Powder Metallurgy-Metals Hand Book -ASM, USA - Vol.7, 1974.
2. Composite Materials - Science and Engineering - Chawla K.K. , - Springer - Verlag, New york - 2nd edition, 1998.
3. Cast Metal Matrix Composites ASM Metals Hand Book - P.K. Rohagti - VI5.
4. Elements of Material Science and Engineering - Van Vlack L.H. - Addison Wesley, NY- 1989.
5. Material science and metallurgy - by Callister, John Willey & Sons.

MODELING, SIMULATION AND ANALYSIS OF MANUFACTURING SYSTEMS			
Course Code	20MST251	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Principles of Modelling & Simulation: Basic Simulation Modeling, Limitation of Simulation, Monte – Carlo Simulation, Areas of Applications, Discrete and Continuous Systems.

Module-2

Modeling Approaches: Modeling Complex Systems, Simulation Software, Basics Probability and Statistics, Building Valid and Credible Simulation Models.

Module-3

Random Number and Variable Generation: Selecting Input Probability Distributions, Random Number Generators, Generating Random Variants, and Output Data Analysis for a Single System.

Module-4

Statistical Techniques: Comparison of Alternative Systems, Variance Reduction Techniques.

Module-5

Simulation Studies: Discrete Event Simulation, Simulation of Inventory Problems, Experimental Design and Optimization, Simulation of Manufacturing Systems, Case Studies.

Course outcomes:

At the end of the course the student will be able to:

1. Know about various techniques of simulation and modeling used to analyse manufacturing system.
2. Undergo various case studies using real time simulation.
3. understand variables involved and analyse output.
4. Awareness of statistical techniques
5. knowledge of simulation in real time applications.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

1. Simulation, Modeling and Analysis –Averill Law & David M.Kelt on, TMH 3rd Edition.
2. Discrete event and Simulation Systems – Banks & Carson, Prentice Hall Inc.

Reference Books

1. “System Simulation” - Gordon, PHI.
2. “System Simulation with Digital computer” – Deo, PHI
3. “Computer Simulation and Modeling” – Francis Neelam kovil, John Wiley & Sons.

BIO MATERIAL AND TECHNOLOGY			
Course Code	20MST252	CIE Marks	40
Teaching Hours/Week (L:P: SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction: Definition of Bio material, Classification of Bio materials, Comparison of properties of some common bio materials, effects of physiological fluid on properties of biomaterials, surface properties, physical and Mechanical properties of Bio materials. Metallic Implants Materials: Stainless Steel, Co-based alloys, Ti and Ti based alloys, Important of stress corrosion cracking, Host tissue reaction with Bio metal, corrosion behaviour, hard tissue replacement implant, orthopaedic implant, dental implants, Percutaneous and skin implants, Vascular implants, Heart valve implant.

Module-2

Polymeric Implant Materials: polyolefins, polyamides, acrylic polymers, fluoro carnon polymers, Silicon rubber acetals. Visco elastic behaviour, creep recovery, stress relaxation, strain rate sensitivity, importance of molecular structure, hydrophilic and hydrophobic surface properties, migration of additives, aging and environmental stress cracking, physiochemical characteristics of bio polymers, bio degradable polymers for medical purpose and their biological applications. Ceramic Implant Materials: Definitions of Bio ceramics, common type of Bio ceramics, Aluminium oxides, Glass ceramics, Carbons. Bioresorbable and Bioactive ceramics, Importance of wear resistance and low fracture toughness. Host Tissue reactions, Importance of Interfacial tissue reaction.

Module-3

Composite Implant Materials: Mechanics of improvement of properties by incorporating different elements. Composite theory of fiber reinforcement, polymers filled with osteogenic fillers (e.g. hydrosyapatite). Host tissue reactions. Bio Compatibility And Toxicological Screening Of Bio Materials: Definition of bio compatibility, blood compatibility and tissue compatibility, toxicity tests, acute and chronic toxicity (in situ implantation, tissue culture, haemolysis, thrombogenic, potential test, systemic toxicity, intracutaneous irritation test), sensitization, carcinogenicity, mutagenicity and special tests.

Module-4

Testing Of Bio Materials Implants: In vitro testing (Mechanical testing): tensile, compression, wears, fatigue, corrosion studies and fracture toughness. In vivo testing (animals): biological performance of implants. Exo-vivo testing, standards of implant materials.

Module-5

Sterilisation Techniques: ETO, gamma radiation, autoclaving, Effects of Sterilisation on material properties.

Course outcomes:

At the end of the course the student will be able to:

- Students will be able to know various biomaterials
- Knowledge of its testing methods
- will be able to understand the significance of its use in various industrial applications.
- Apply sterilization techniques in industry.
- Develop models to demonstrate his knowledge.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

1., Biological performance of materials, Jonathan Black, MarceDecker,1981.
2., Blood Compatible Materials and Devices, C.P. Sharma & M. Szyehen, Technonic Publishing Co Ltd.,1991.

Reference Books

1, Polymetric Biomaterials. Piskin and S.Hofmann Mantinus Nijhoff publication bordrechnt 1986.
2., Biomaterials, Science and engineering, J.B. Park, Plenum Press 1984
3. Biomaterials, Sujata V. Bhat, Narosa Publishing House – 2002

MECHANICAL BEHAVIOUR OF MATERIALS			
Course Code	20MST253	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Strength of materials- basic assumptions, elastic and plastic behaviour, stress–strain relationship for elastic behaviour, elements of plastic deformation of metallic materials Mohr's circle, yielding theories. Theory of plasticity: Elements of theory of plasticity, dislocation theory properties of dislocation, stress fields around dislocations, application of dislocation theory to work hardening, solid solution strengthening, grain boundary strengthening, dispersion hardening.

Module-2

Ductile and Brittle Fracture: Ductile and brittle fracture, Charpy and Izod testing, significance of DBTT, ECT, NDT and FATT; elements of fractography - Griffith's theory, LEFM– COD and J integral –determination of KIC, COD and J integral. Characteristics of fatigue failure: Initiation and propagation of fatigue cracks, factors affecting fatigue strength and methods of improving fatigue behaviour – testing analysis of fatigue data mechanics of fatigue crack propagation, corrosion fatigue.

Module-3

Introduction to creep: - creep mechanisms, creep curve, variables affecting creep, accelerated creep testing, development of creep resistant alloys, Larsen Miller parameter – Manson Hafred parameter.

Module-4

Stages of failure analysis, classification and identification of various types of fracture.Overview of fracture mechanics, characteristics of ductile and brittle fracture. General concepts, fracture characteristics revealed by microscopy, factors affecting fatigue life Creep, stress rupture, elevated temperature fatigue, metallurgical instabilities, environmental induced failure. Some case studies failures.

Module-5

Types of wear, analyzing wear failure. Corrosion failures- factors influencing corrosion failures, overview of various types of corrosion stress corrosion cracking, sources, characteristics of stress corrosion cracking. Procedure for analyzing stress corrosion cracking, various types of hydrogen damage failures. Causes of failure in forging; failure of iron and steel castings, improper heat treatment, stress concentration and service conditions. Failure of weldments - reasons for failure procedure for weld failure analysis.

Course outcomes:

At the end of the course the student will be able to:

- Students will develop skill sets to analyse behaviour of materials
- analyse its characteristics to find its adoptability for an industrial application.
- Identify various stages of failure
- Thorough knowledge of wear
- Understand the stages of failure

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

1. Mechanical Behaviour of Materials (MCGRAW HILL SERIES IN MATERIALS SCIENCE AND ENGINEERING) Hardcover – Import, 1 Mar 1990 – Thomas Courtney.
2. Mechanical Behavior of Materials: Second Edition Front Cover Thomas H. Courtney Waveland Press, 16-Dec-2005 - Technology & Engineering.
3. Mechanical Metallurgy', Dieter G. E 3rd Edition, McGraw Hill, 1988.
4. Testing of Metallic Materials', Suryanarayana Prentice Hall India, 1979.
5. Structure and Properties of Materials', Rose R. M., Shepard L. A., Wulff J., Volume III, 4th Edition, John Wiley, 1984

Reference Books

1. ASM Metals Handbook "Failure Analysis and Prevention", ASM Metals Park. Ohio, Vol.10, 10th Edition, 1995.
2. "Analysis of Metallurgical Failures", Colangelo.V.J. and Heiser.F.A., John Wiley and Sons Inc. New York, USA, 1974.

NON-DESTRUCTIVE TESTING			
Course Code	20MST254	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction to ND Testing: selection of ND methods, visual inspection, leak testing, Liquid penetration inspection, its advantages and limitation. Magnetic Particle Inspection: Methods of generating magnetic field, types of magnetic particles and suspension liquids steps in inspection – application and limitations.

Module-2

Eddy Current Inspection: principles, operation variables, procedure, inspection coils, and detectable discounts by the method. Microwave Inspection: Microwave, holography, applications and limitations. Ultrasonic Inspection: Basic equipment characteristics of ultrasonic waves, variables inspection, inspection methods pulse echo A, B, C scans transmission, resonance techniques, transducer elements couplets, search units, contact types and immersion types inspection standards-standard reference blocks.

Module-3

Radiography Inspection: principles, radiation source X-rays and gamma rays, X-ray tube, radio graphic films, neutron radiography, Thermal inspection principles, equipment inspection methods applications.

Module-4

Optical Holography: Basics of Holography, recording and reconstruction – Acoustical Holography: systems and techniques applications. Indian standards for NDT.

Module-5

Visual Inspection and Thermographic methods: Acoustic emission, Total acoustic emission, felicity ratio, Generation of Acoustic Emission. .

Course outcomes:

At the end of the course the student will be able to:

1. Understand and analyze the significance and suitability of various non-destructive testing for different industrial applications. (PO-1,2)
2. Analyze different metals and alloys by visual inspection method and Thermo graphic method. (PO-2,3)
3. Perform non-destructive tests like: Liquid penetrant test, Magnetic particle test, Eddy current test and Ultrasonic test, X-ray and Gamma ray radiography. (PO-4,5)
4. Identify defects by using relevant NDT methods. .(PO-2,3)
5. Apply the knowledge of optical holography and industrial applications according to Indian standards for NDT. (PO-1,2)

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

Non-Destructive Testing Techniques Hardcover – 1 Jan 2010 by Ravi Prakash

. The Testing Instruction of Engineering Materials - Davis H.E Troxel G.E wiskovil C.T- McGraw hill.

Reference Books

1. Non-Destructive Testing - Mc Gonnagle JJ – Garden and reach New York.
2. Non-Destructive Evolution and Quality Control - volume 17 of metals hand book 9 edition Asia internal 1989.

TITLE OF THE LABORATORY Materials Characterisation Laboratory - 2			
Course Code	20MSTL26	CIE Marks	40
Teaching Hours/Week (L:P: SDA)	0:4:0	SEE Marks	60
Credits	02	Exam Hours	03

Sl.NO	**Experiments**
	1. Polishing Etching and microstructure analysis of Mild steel, Aluminium and Copper
	2. Study of variation in Microstructure of dual phase stainless steels after heat treatment
	3. Hardness analysis of polymer, Aluminium and mild steel (Before and after heat treatment)
	4. Temperature Data Aquisition System
	5. Study of Ultrasonic Flaw detector
	6. Study of Atomic Force Microscopy
	7. Study of Scanning electron microscopy
	8. Casting of Aluminium alloy
	9. Specimen preparation and tensile and compressive test of Aluminium alloy
	10. Specimen preparation and impact testing of Aluminium alloy.

Any 6 experiments to be taught

TECHNICAL SEMINAR			
Course Code	20MST27	CIE Marks	100
Number of contact Hours/week (L:P:SDA)	0:2:0	SEE Marks	--
Credits	02	Exam Hours	--

Course objectives:

The objective of the seminar is to inculcate self-learning, face audience confidently, enhance communication skill, involve in group discussion and present and exchange ideas.

Each student, under the guidance of a Faculty, is required to

- Choose, preferably through peer reviewed journals, a recent topic of his/her interest relevant to the Course of Specialization.
- Carryout literature survey, organize the Course topics in a systematic order.
- Prepare the report with own sentences.
- Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities.
- Present the seminar topic orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit two copies of the typed report with a list of references.

The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

The CIE marks for the seminar shall be awarded (based on the relevance of the topic, presentation skill, participation in the question and answer session and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculties from the department with the senior most acting as the Chairperson.

Marks distribution for CIE of the course 20XXX27 seminar:

Seminar Report: 30 marks

Presentation skill:50 marks

Question and Answer:20 marks

*** END OF II SEMESTER***

PLASTIC PROCESSING			
Course Code	20MST31	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Plastic Processing: Basic principle of processing, shape and size, processing parameters, their effect and behavior, Rheology of ideal fluids, and real polymers, Effects of melt behavior on processing and product performance. Injection Moulding: Principles, process variables, moulding cycle, machinery used, parts and function, specification, construction and maintenance of injection moulding machine, start up and shut down procedure, cylinder, nozzles, interaction of moulding variables, press capacity, projected area, shot weight, concepts and their relationship to processing, trouble shooting in injection moulding, microprocessors controlled injection moulding machines.

Module-2

Extrusion: Basic principles of extruders, and extrusion process, different types of extrudes i.e. barrel, screw, drive mechanics, head, constructional features of dies, sizing and haul-off equipment for extruders of mono filaments and tubes, blown film lines, wire and cable covering system, pipe profile extrusion, co-extrusion, process variables in extrusion like heating, temperature control, dies well, and melt fracture, spacing and orientation, treating, printing and sealing, quality of extruder products, fault, causes and remedy. Compression and Transfer Moulding: Techniques, various types of compression moulds, machinery used, and common moulding faults and remedies. Transfer moulding, its advantage over compression moulding, equipment used, press capacity, integral mold, and auxiliary mould, moulding cycle, ram pressure, clamping pressure, faults and remedies.

Module-3

Blow Moulding: Blow moulding process, processing parameter, materials used, hand operated and automatic blow moulding machine, extrusion blow moulding, moulding cycle, faults and remedies. Thermo Forming: Basic principles, types of thermoforming, thermoforming moulds, processing parameters, faults and remedies. Rotational Moulding: Basic principle, charge size, wall thickness, temperature control, fault causes and remedies.

Module-4

Calendaring: Basic principle, process variable, end product properties and applications, secondary processing techniques like powder coating, casting, machining, and joining of plastics, metalizing, printing.

Module-5

Processing of Engineering Plastics: precautions, and start up procedure, preheating, shutdown procedure, quality control, and waste management. Ram Extrusion of PTFE, Processing of reinforced plastics, like filament winding, Hand-lay-up, spray moulding, SMC, DMC, Centrifugal casting, pultrusion, resin transfer moulding.

Course outcomes:

At the end of the course the student will be able to:

- Students will demonstrate their understanding of plastic processing, injection moulding, extrusion and thermo forming.
- Application of various processes for practical purposes.
- Knowledge of different plastic materials.
- Design & Execution of plastic processing equipments.
- Metallurgical behavior of materials.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

Handbook of Plastic Processes Editor(s): Charles A. Harper First published:7 October 2005 Print ISBN:9780471662556 |Online ISBN:9780471786580 |DOI:10.1002/0471786586 Copyright © 2006 John Wiley & Sons, Inc.

Plastics processing technology Front Cover Edward A. Muccio ASM International, 1994 - Technology & Engineering - 320 pages

Plastic Processing Data Hand Book – Dominic V Rosat o P.E.

Modern Plastics Hand Book – Charles A Harper.

Reference Books

1. Injection Mould Design, Pye R.G. W. - New York-John Wiley & Sons 12th Ed.1989.
2. Injection Moulding Theory & Practice, Rubin. J. Irvin, New York John Wiley & Sons.
3. Blow Moulding Hand Book, Rosato, New York-Oxford University-Hanser Publishers.
4. Principles of Rotational Moulding Process, Bruins.

EXPERIMENTAL METHODS IN ENGINEERING			
Course Code	20MST321	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Module-1

Introduction: Basic concepts of measurement methods, single and multipoint measurement Min space and time. Processing of experimental data, curve fitting and regression analysis. Data Acquisition systems: Fundamentals of digital signals and their transmission, A/D-and D/A converters, Basic components of data acquisition system. Computer interfacing of digital instrument and data acquisition systems; Digital multiplexes, Data acquisition board (DAQ), Digital image processing fundamentals.

Module-2

Design and Construction of Experimental facilities: wind tunnel, general test rigs, Test cells for flow visualization and temperature mapping. Modeling and Simulation of Measurement System: Lumped analysis, first order and second order systems: Frequency response and time constant calculation. Response of a generalized instrument to random data input, FFT analysis.

Module-3

Temperature Measurement: Measurement Design, Construction and Analysis of liquid and gas thermometers, resistance thermometer with wheat stone bridge, Thermo-electric effect, Construction, testing and calibration of thermocouples and thermopiles, Analysis of effect of bead size and shielding on time constant and frequency response, characteristics of thermocouple, pyrometers, radiation thermometers. Interferometry & Humidity measurement: interferometers, Humidity measurement: Conventional methods, electrical transducers, Dunmox humidity and microprocessor-based dew point instrument, Calibration of humidity sensors.

Module-4

Flow and Velocity Measurement: Industrial flow measuring devices, design, selection and calibration, velocity measurements, pitot tubes, yaw tubes, pitot static tubes; frequency response and time constant calculation. Hot-wire anemometer; 2d/3d flow measurement and turbulence measurement, Laser application in flow measurement, Flow visualization techniques, Combustion photography.

Module-5

Measurement of Pressure, Force, and Torque: Analysis of liquid manometer, dynamics of variable area and inclined manometer, Pressure transducers, Speed and torque measurement: speed and torque measurement of rotating system. Air Pollution sampling and measurement: Units for pollution measurement, gas sampling techniques, particulate sampling technique, gas chromatography.

Course outcomes:

At the end of the course the student will be able to:

- Students learn various experimental and measurement techniques which they can adopt in practical applications.
- Ability to set-up experimental facilities
- Learn temperature measurements.
- Knowledge of flow and velocity measurement.
- **Learn** different measurement techniques for pressure, force.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

1. Experimental Methods for Engineers - J.P. Holman, McGraw-Hill Publications, 8th Edition.

Reference Books

1. Mechanical Measurements - Beckwith M.G., Marangoni R.D. and Lienhard J.H., Pearson Education.
2. Measurements Systems-Application and Design - E.O. Doebelin, Tata McGrawHill Publications.

MANUFACTURING OF ELECTRONIC COMPONENTS			
Course Code	20MST322	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Module-1

Introduction: Important components of Electronic products. Types of Semiconductor materials and properties and their properties. Manufacturing ICs: The functions of Ics manufacturing of diodes. Production of a single I c component classification of Ic Architecture.

Module-2

Manufacturing of Silicon Water: fabrication of IC on silicon wafers Fabrication of IC on Silicon wafers. Diffusion doping, Ion Implantation, Rapid thermal processing- Thermal oxidation Monolithic processing, Lithography, Photolithography, Etching processes. Thin film Deposition: Physical vapour Deposition, chemical vapor deposition, Epitoxial growth, IC component interconnection, IC yield and economics.

Module-3

IC packing. Types of packaging process. Printed Circuit Boards: Typical substrate (base) Materials and selection of substrate materials, Types of PCBs. Methods of manufacturing Of PCBs.

Module-4

Electronic Assembly: General Description of Electronic Assembly detailed study of sequences of operation for through-hole and surface mount process.

Module-5

Micro Electro-Mechanical systems Introduction to micro sensors MEMS, micro machines fundamentals of Silicon micro machining- Bulk & surface micromachining. Micro stereo lithography. Micro sensors: Types & brief description and applications of Thermal and Smart sensors & MEMS Devices.

Course outcomes:

At the end of the course the student will be able to:

- Students will be able to realise intricate manufacturing techniques associated with manufacturing electronic components.
- Demonstrate fabrication techniques.
- Thorough knowledge of circuit boards.
- Knowledge of MEMS
- Ability to identify various manufacturing process.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

1.: Materials and processes in manufacturing, E. Paul Degarmo, IT Black and Ronald A Kohser Wiley student Edition 2004

2. Electronics materials handbook Vol 1., Minger ML Packing ASM

Reference Books

1. RF: Semiconductor fundamentals Addisor-Wisley, Reading mass.1998.

2.: Electronic materials & processes handbook, CA Harper & RM Sampson 2nd Edition Mc GrawHill 1994.

Jarger RC: introduction to Microelectronic Fabrication. Addision – Wesley 1990

3.The science and Engineering of microelectronics, Cambell , Oxford University press 2001.

NON-TRADITIONAL MACHINING			
Course Code	20MST323	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Module-1

Introduction: Need for non-traditional machining processes, Process selection, classification, comparative study of different processes. Ultra-Sonic Machining: Definition, Mechanism of metal removal, elements of the process, Tool feed mechanisms, Theories of mechanics, effect of parameters, Different types of concentrators, horn design, applications, Limitations. Abrasive Jet Machining: Principle, Process parameters, Influence of process parameters on MRR , applications, advantages and disadvantages. Water Jet Machining: Principle, Equipment, Operation, Application, Advantages and limitations of water Jet machinery.

Module-2

Thermal Metal Removal Processes: Electric discharge machining, Principle of operation, mechanism of metal removal, basic EDM circuitry, spark erosion generators, Analysis of relaxation type of circuit, material, removal rate in relaxation circuits, critical resistance parameters in Ro Circuit, Die electric fluids, Electrodes for spark erosion- surface finish, applications. Electro Chemical machining (ECM): Classification of ECM process, Principle of ECM, Chemistry of the ECM process, parameters of the process, Determination of the metal removal rate, dynamics of ECM process, Hydrodynamics of ECM process, polarization, Tool Design, advantages and disadvantages-applications. Electro Chemical grinding, Electro Chemical honing, Electrochemical deburring.

Module-3

Chemical Machining: Introduction, fundamental principle types of chemical machining, Maskants, Etchants, Advantages and disadvantages, applications, chemical blanking, chemical milling (contour machining), Hydrogen embrittlement. Plasma arc Machining: Introduction, Plasma, Generation of Plasma and equipment, Mechanism of metals removal, PAM parameters, process characteristics, types of torches, applications. Electron beam machining (EBM): Introduction, Equipment for production of Electron beam, Theory of electron beam machining, Thermal & Non thermal type, Process characteristics, applications.

Module-4

Laser Beam Machining: Introduction, principles of generation of lasers, Equipment and Machining Procedure, Types of Lasers, Process characteristics, advantages and limitations, applications of laser beam machining. CO2 Laser: Principle, Equipment, Applications. Ion Beam Machining: principle, equipment, working, sputtering rate, applications.

Module-5

High Velocity forming processes: Introduction, development of specific process, selection, comparison of conventional and high velocity forming methods.Types of high velocity forming methods: explosion forming process, electro-hydraulics forming, magnetic pulse forming. Applications, Advantages and limitations.

Course outcomes:

At the end of the course the student will be able to:

1. Student will be in a position to appreciate the merits of non traditional machining and its application in Industries.
2. Justify and demonstrate the benefits of non-traditional machining processes over traditional machining processes.
3. Students will be able to decide a process suitable for a particular material based on the availability of the sources.
4. understand the applicability of the process and its benefits.
5. Ability to setup NTM in any industry.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

1. Modern Machining Process - P.C Pandey & H.S Shan Tata Mc Graw Hill.
2. Modern Machining Processes - P.K Mishra, Paperback – Import, 30 Jan 1997, Narosa publishers.
3.Thermal Metal Cutting Processes-Dr.B.J. Ranganatha, I K International, New Delhi

Reference Books

1. New technology - Bhattacharya, Institution of Engineers, India
2. Production technology - HMT Tata Mc Graw Hill.
3. Metals hand book - ASM Vol-3.
4. High velocity forming of metals - F.M Wilson ASTME PrenticeHall.
5. Modern Manufacturing Methods - Adithan

VACUUM SCIENCE & CRYOGENICS			
Course Code	20MST324	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Module-1

Behavior of Gases; Gas Transport Phenomenon, Viscous, molecular and transition flow regimes, Measurement of Pressure, Residual Gas Analyses; Production of Vacuum - Mechanical pumps, Diffusion pump, Getter and Ion pumps, Cryopumps.

Module-2

Materials in Vacuum; High Vacuum, and Ultra High Vacuum Systems; Leak Detection. Properties of engineering materials at low temperatures; Cryogenic Fluids - Hydrogen, Helium 3, Helium 4.

Module-3

Superfluidity, Experimental Methods at Low Temperature: Closed Cycle Refrigerators, Single and Double Cycle He3 refrigerator, He4 refrigerator, He3-He4 dilution refrigerator, Pomeranchuk Cooling, Pulsed Refrigerator System, Magnetic Refrigerators, Thermoelectric coolers;

Module-4

Cryostat Design: Cryogenic level sensors, Handling of cryogenic liquids, Cryogenic thermometry.

Module-5

Cryogenic Refrigerators: J.T. Cryocoolers, Stirling Cycle Refrigerators, G.M. Cryocoolers, Pulse Tube Refrigerators, Regenerators used in Cryogenic Refrigerators, Magnetic Refrigerators Storage and transfer of Cryogenic liquids, Design of storage vessels.

Course outcomes:

At the end of the course the student will be able to:

CO1: Students will learn about the behavior gasses.

CO2: The concept of low, high and ultra-high vacuum and its measurements.

CO3: The concept of Low temperature, liquification's of the gases to create low temperature in different temperature ranges.

CO4: Learn about the design of low temperature systems.

CO5: Understanding of cryogenics.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

1. Vacuum science and technology by Paul A Redhead, American Institute of Physics.
2. Handbook of Vacuum Science and Technology by Dorothy Hoffman, Academic Press
3. Foundations of Vacuum Science and Technology by James M. Lafferty, Wiley-Interscience

Reference Books

1. F. Barron, *Cryogenic Systems*, McGraw Hill, 1985.
2. K. D. Timmerhaus and T.M. Flynn,, *Cryogenic Process Engineering,*, Plenum Press, 1989
3. Mukhopadhyay, *Fundamentals of Cryogenic Engineering*, PHI Learning Pvt. Ltd., New Dlehi, 2010
4. R. B. Scott, *Cryogenic Engineering*, Van Nostrand and Co., 1962

ELECTRONIC, OPTICAL AND MAGNETIC PROPERTIES OF MATERIALS			
Course Code	20MST331	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Module-1

Lattice Vibrations: Hamiltonian Mechanics, Vibrations in Crystals-Phonons, Elastic Bandgap. Review of free electron and band theories of solids, Electrical conduction in metals and semiconductors, Hall effect, Temperature dependence of electrical conductivity.

Module-2

Quantum Mechanics: Schrodinger's Equation, 1-Dimensional Problems, Measurements-The Ehrenfest Theorem, Three Dimensions-Hydrogen Atom.

Module-3

Electronic Band Structures: Periodic Potential, Central Equation, Understanding Band Diagrams, Engineering conductivity in Semiconductors.

Module-4

Solid-State Devices: PN Junctions, Solar Cells, LEDs. Optical Properties: Wave Equation, E/M Waves at Interfaces, Photonic Crystals.

Module-5

Magnetic Properties: Introduction, Dia, Para and Ferromagnetism, Weiss Field and Magnetic Domains, Anti ferromagnetism and Ferri magnetism. Ferromagnetic anisotropy and magnetostriction. Magnetic energy and Domain structure, Hysteresis loop. Soft and Hard magnetic Materials.

Course outcomes:

At the end of the course the student will be able to:

- Understand the various properties of materials
- Knowledge of materials
- Ability to identify materials for practical purpose.
- Identify the potential of the materials.
- Real time application.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

1. Electronic, Magnetic, and Optical Materials (Advanced Materials and Technologies)-Pradeep Fulay & Jung-Kun Lee, CRC Press, Taylor & Francis Group.
2. Hyperlink: https://www.edx.org/course/electronic-optical-magnetic-properties-mitx-3-024x
3. Electronic properties of Materials, Hummel, R.E., Springer
4. Magnetic Materials, Azaroff, L.I, McGrawhill.

PARTICULATE TECHNOLOGY			
Course Code	20MST332	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Module-1

Introduction to particulate processing – advantages, limitations and applications of particulate processing.

Module-2

Science of particulate processing – issues related to particle morphology – differences in mechanical behaviour (with respect to cast and wrought materials) and related mathematical treatment - similarities and differences between metal powder and ceramic powder processing.

Module-3

Production and characterisation of metal and ceramic powders – compaction processes –powder properties and powder compaction – Pressing, Hot Isostatic Processing and extrusion.

Module-4

Sintering – thermodynamic and process aspects – recent developments in mechanical alloying and reaction milling.

Module-5

Production of particulate composites - application of P/M based on case studies -manufacturing of typical products – near net shape processing.

Course outcomes:

At the end of the course the student will be able to:

- Understand the technology involved in Particles.
- Learn to various powder processing techniques.
- Commercial application of knowledge.
- Identify the problems in Industry
- Suggest practical answers.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

1. Introduction to Particle Technology, Second Edition Author(s): Martin Rhodes chemical engineering, PhD, First published:7 March 2008 Print ISBN:9780470014271 |Online ISBN:9780470727102 |DOI:10.1002/9780470727102 Copyright © 2008 John Wiley & Sons, Ltd.
2. Powder Metallurgy Science', German R.M,Metal Powder Industries Federation, NewJersey, 1994.
3. Powder Metallurgy Processing - New Techniques and

Analysis', Kuhn H. A. and Alan Lawley Oxford IBH, Delhi, 1978

CORROSION SCIENCE AND TECHNOLOGY			
Course Code	20MST333	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Module-1

Definition of corrosion, corrosion damage, classification of corrosion, electrochemical aspects, electrochemical reactions, mixed potential theory, Electrode potential, Nernst equation. oxy-reduction potentials.

Module-2

Corrosion thermodynamics – Pourbaix diagrams; Polarization of the corrosion cell; Activation controlled kinetics and concentration polarization, Evans diagrams, partial corrosion reactions- anodic dissolution of metals; Cathodic reactions – oxygen reduction and hydrogen evolution.

Module-3

Corrosion of materials in natural environments; Atmospheric corrosion, general characteristics, mechanism and prevention; soil corrosion – general characteristics, mechanism and prevention. Localized corrosion damages and materials failure- passivity and transpassivity of metals, breakdown of passivity and pitting corrosion. Stress – corrosion cracking of materials. Inter-granular corrosion failure. Corrosion failure of ceramic materials; mechanisms of corrosion of ceramics, effect of chemical, phase composition and structure on corrosion resistance. Corrosion degradation of concrete.

Module-4

Tafel and linear polarisation, AC impedance, small-amplitude cyclic voltammetry. Paint tests, sea water tests. Interpretation of results, Corrosion prevention; materials selection, alteration of environment, design, cathodic and anodic protection coating.

Module-5

Environmental effects from the chemical processes industry (like Pulp mill operations, bleach plants, boilers, paper machine, water treatment plants in the pulp and paper industry and others), infrastructure, and transportation industry. Safety aspects. .

Course outcomes:

At the end of the course the student will be able to:

- Good knowledge of Corrosion Science.
- Assesment of its impact on its environment.
- Suggest the right technique
- Understand the safety aspects
- Prevent Environment degradation.
-

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

Corrosion Science and Engineering (English, Hardcover, Pedeferri Pietro, Publisher: Springer International Publishing AG, 2016.

1. Mars G. Fontana, Corrosion Engineering, McGraw-Hill Book Company, 1986.
2. David Talbot and James Talbot, Corrosion Science and Technology, CRC Press, New York, 1998.
3. Denny A. Jones, Principles and Prevention of Corrosion, Maxwell Matemillar 1992.
4. D. A. Jones: Principles and Prevention of Corrosion, Macmillan Publ. Co. (1996).
5. 2. C. Scully: The Fundamental of Corrosion, 2nd ed., Pergamon Press: E. Stansbury and R. A. Buchanan, Fundamentals of Electrochemical Corrosion, ASM International (2000).
6. 3. M.G. Fontana: Corrosion Engineering, 3rd. Ed., McGraw Hill. (1986)
7. 4. J. M. West: Electrodeposition and Corrosion Control, J. Wiley W. Revie (ed.):
8. Corrosion Handbook, Electrochemical Society Series, John Wiley and Sons (2000).
9. 5. W. Revie (ed.): Corrosion Handbook, Electrochemical Society Series, John Wiley and Sons, 2000: Metals Handbook, Vol. 13: Corrosion, ASM International

Reference Books

1. Fontana, Mars G, Advances in corrosion science and technology vol 6. 2012
2. Landolt, Dieter, Corrosion and surface chemistry of metals -- 2007
3. Uhlig, Herbert, Corrosion and corrosion control – 4th edn,1984.

RELIABILITY ENGINEERING			
Course Code	20MST334	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Module-1

Basic Probability Theory Basic concepts, Rules for combining Probabilities of events, Failure Density and Distribution functions, Bernoulli's trials, Binomial distribution, Expected value and standard deviation for binomial distribution – Examples.

Module-2

Failure Mode and Effect Analysis (FMEA) Basic Principles and General Fundamentals of FMEA Methodology.

Module-3

Design of Experiments Analysis of Variance Technique-Strategy of Experimental Design .

Module-4

Product Liability and Planning History, Product Safety Law, Product Liability Law, The future of product Liability- Prevention. Degree of Novelty of a Product, Product Life Cycle, Company Goals and Their Effect. Solution Finding Methods- Conventional Methods, Intuitive Methods, Discursive Methods, Methods for Combining Solutions- Examples.

Module-5

Product Development Process General Problem-Solving Process- Flow of Work During the Process of Designing, Activity Planning, Timing and Scheduling, Planning Project and Costs, Effective Organization Structures- Interdisciplinary Cooperation, Leadership and Team Behaviour.

Course outcomes:

At the end of the course the student will be able to:

- Understand major concepts of reliability prediction.
- Analyze statistical experiments leading to reliability modeling.
- Identify reliability testing components.
- Apply reliability theory to assessment of reliability in engineering design.
- Use control charts to analyze for improving the process quality

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

1. AN INTRODUCTION TO RELIABILITY AND MAINTAINABILITY ENGINEERING by Charles Ebeling | 1 July 2017, McGraw Hill Edition.
2. Probability, Queuing Theory & Reliability Engineering G. Haribaskaran,, Laxmi publications, Second Edition.
3. Total Quality Management, D. H. Besterfield, Glen H. Besterfield and M. Besterfield-Sacre, Pearson Publications, Third Edition.
4. Probability and Statistics for engineering and Scientists, E. Walpole, H. Myers and L. Myers Pearson Publications, Eighth Edition.
5. Reliability in Automotive and Mechanical Engineering, Brend Bretsche Springer Publications.

PROJECT WORK PHASE – 1			
Course Code	20MST34	CIE Marks	100
Number of contact Hours/Week	2	SEE Marks	--
Credits	02	Exam Hours	--

Course objectives:

- Support independent learning.
- Guide to select and utilize adequate information from varied resources maintaining ethics.
- Guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- Develop interactive, communication, organisation, time management, and presentation skills.
- Impart flexibility and adaptability.
- Inspire independent and team working.
- Expand intellectual capacity, credibility, judgement, intuition.
- Adhere to punctuality, setting and meeting deadlines.
- Instil responsibilities to oneself and others.
- Train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Project Phase-1 Students in consultation with the guide/s shall carry out literature survey/ visit industries to finalize the topic of the Project. Subsequently, the students shall collect the material required for the selected project, prepare synopsis and narrate the methodology to carry out the project work.

Seminar: Each student, under the guidance of a Faculty, is required to

- Present the seminar on the selected project orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit two copies of the typed report with a list of references.

The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Course outcomes:

At the end of the course the student will be able to:

- Demonstrate a sound technical knowledge of their selected project topic.
- Undertake problem identification, formulation, and solution.
- Design engineering solutions to complex problems utilising a systems approach.
- Communicate with engineers and the community at large in written an oral forms.
- Demonstrate the knowledge, skills and attitudes of a professional engineer.

Continuous Internal Evaluation

CIE marks for the project report (50 marks), seminar (30 marks) and question and answer (20 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session by the student) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with the senior most acting as the Chairperson.

MINI PROJECT			
Course Code	20MST35	CIE Marks	100
Number of contact Hours/Week	2	SEE Marks	--
Credits	02	Exam Hours/Batch	03

Course objectives:

- To support independent learning and innovative attitude.
- To guide to select and utilize adequate information from varied resources upholding ethics.
- To guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- To develop interactive, communication, organisation, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire independent and team working.
- To expand intellectual capacity, credibility, judgement, intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instil responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Mini-Project: Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

Course outcomes:

At the end of the course the student will be able to:

- Present the mini-project and be able to defend it.
- Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
- Habituated to critical thinking and use problem solving skills.
- Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
- Work in a team to achieve common goal.
- Learn on their own, reflect on their learning and take appropriate actions to improve it.

CIE procedure for Mini - Project:

The CIE marks awarded for Mini - Project, shall be based on the evaluation of Mini - Project Report, Project Presentation skill and Question and Answer session in the ratio 50:25:25.The marks awarded for Mini - Project report shall be the same for all the batch mates.

Semester End Examination

SEE marks for the mini-project shall be awarded based on the evaluation of Mini-Project Report, Presentation skill and Question and Answer session in the ratio 50:25:25 by the examiners appointed by the University.

INTERNSHIP / PROFESSIONAL PRACTICE			
Course Code	20MSTI36	CIE Marks	40
Number of contact Hours/Week	2	SEE Marks	60
Credits	06	Exam Hours	03

Course objectives:

Internship/Professional practice provide students the opportunity of hands-on experience that include personal training, time and stress management, interactive skills, presentations, budgeting, marketing, liability and risk management, paperwork, equipment ordering, maintenance, responding to emergencies etc. The objective are further,

To put theory into practice.

To expand thinking and broaden the knowledge and skills acquired through course work in the field.

To relate to, interact with, and learn from current professionals in the field.

To gain a greater understanding of the duties and responsibilities of a professional.

To understand and adhere to professional standards in the field.

To gain insight to professional communication including meetings, memos, reading, writing, public speaking, research, client interaction, input of ideas, and confidentiality.

To identify personal strengths and weaknesses.

To develop the initiative and motivation to be a self-starter and work independently. ■

Internship/Professional practice: Students under the guidance of internal guide/s and external guide shall take part in all the activities regularly to acquire as much knowledge as possible without causing any inconvenience at the place of internship.

Seminar: Each student, is required to

- Present the seminar on the internship orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit the report duly certified by the external guide.
- The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident. ■

Course outcomes:

At the end of the course the student will be able to:

- Gain practical experience within industry in which the internship is done.
- Acquire knowledge of the industry in which the internship is done.
- Apply knowledge and skills learned to classroom work.
- Develop a greater understanding about career options while more clearly defining personal career goals.
- Experience the activities and functions of professionals.
- Develop and refine oral and written communication skills.
- Identify areas for future knowledge and skill development.
- Expand intellectual capacity, credibility, judgment, intuition.
- Acquire the knowledge of administration, marketing, finance and economics. ■

Continuous Internal Evaluation

CIE marks for the Internship/Professional practice report (20 marks), seminar (10 marks) and question and answer session (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session by the student) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with the senior most acting as the Chairperson. ■

Semester End Examination

SEE marks for the internship report (30 marks), seminar (20 marks) and question and answer session (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session) by the examiners appointed by the University. ■

PROJECT WORK PHASE -2			
Course Code	20MST41	CIE Marks	40
Number of contact Hours/Week	4	SEE Marks	60
Credits	20	Exam Hours	03

Course objectives:

- To support independent learning.
- To guide to select and utilize adequate information from varied resources maintaining ethics.
- To guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- To develop interactive, communication, organisation, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire independent and team working.
- To expand intellectual capacity, credibility, judgement, intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instil responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Project Work Phase - II: Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism. ■

Course outcomes:

At the end of the course the student will be able to:

- Present the project and be able to defend it.
- Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
- Habituated to critical thinking and use problem solving skills
- Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
- Work in a team to achieve common goal.
- Learn on their own, reflect on their learning and take appropriate actions to improve it. ■

Continuous Internal Evaluation:

Project Report: 20 marks. The basis for awarding the marks shall be the involvement of the student in the project and in the preparation of project report. To be awarded by the internal guide in consultation with external guide if any.

Project Presentation: 10 marks.

The Project Presentation marks of the Project Work Phase -II shall be awarded by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with the senior most acting as the Chairperson.

Question and Answer: 10 marks.

The student shall be evaluated based on the ability in the Question and Answer session for 10 marks.

Semester End Examination

SEE marks for the project report (30 marks), seminar (20 marks) and question and answer session (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session) by the examiners appointed by the University. ■