

**Master of Technology
Surface Coating
Technology Syllabus**

INSTITUTE OF CHEMICAL TECHNOLOGY
Ordinances, Regulations and Syllabi relating to the
Degree of Master of Surface Coating Technology (M. Tech)

1. Introduction

The Institute is revamping its academic structure especially for the master's courses by way of introducing the compulsory industrial training for a period of six months (to be taken in the third semester of the program). The number of credits in the first two semesters has also been increased and a research component has been included. The total credits in the first two semesters now stand at 27 each instead of earlier 21. All the courses will continue to be credit based and the evaluation will be grade based.

The Departmental administrative committee and academic program committee periodically proposed the program outcomes having consistency with the graduate attributes available with NBA. The committee critically analysed information obtained from graduated students, employers and immediately passed out students. The program outcomes are as follows:

SR. NO.	PROGRAM OUTCOMES (POS)
1	The graduates will be able to apply knowledge of basic sciences (Mathematics, Physics, Chemistry and Biology) and engineering courses in getting solutions to issues pertaining to chemical and allied industries.
2	The graduates should be able to systematically break up complex problems in realizable steps and solve them.
3	The graduates will be able to design a system or a component of a system or provide an engineering solution for a specific task within realistic constraints
4	The graduates will be able to design and conduct experiments as well as analyze and interpret data. The graduates should be able to systematically break up complex problems in realizable steps and solve them.
5	The graduate will be able to use modern tools, software, equipment etc. to analyze and obtain solution to the problems.
6	The graduates will be able to study the impact of process industry on the global, economic, and societal context
7	The graduates should practice their profession considering environmental protection and sustainability
8	Graduates are expected to practice professional skills in an ethical manner
9	The graduates should have competence to undertake designated task on individual or team basis as per the requirement.
10	The graduates will be able to communicate effectively their points of view
11	The graduates will acquire attitude for life- long learning
12	The graduates should actively participate in project and financial management

SR. NO.	PROGRAM SPECIFIC OUTCOMES (PSOs)
13	Graduates will be acquainted with the latest development in different fields so as to enable them to take up higher studies, research & developmental work
14	Graduates will be introduced to managerial subjects, so as to enable them to take up further studies in management subjects & function effectively as managers
15	Provide a platform to the students to interact with leading teachers, scientists and industry practitioners

Credit system is a systematic way of describing an educational programme by attaching credits to its components. The definition of credits may be based on different parameters, such as student workload, learning outcomes and contact hours. It is a student-centric system based on the **student workload** required to achieve the objectives of a programme. It should facilitate academic recognition of the courses and mobility of the students. Credits assignment is based on the principle that Credits can only be obtained after successful completion of the work required and appropriate assessment of the learning outcomes achieved. As per the AICTE norms 2L/week of lectures are 2 credits, while 2h/week of practical/ /seminar/literature review/research work are 1 credit. This has been taken as the basis during the working of the proposed syllabus.

Student workload consists of the time required to complete all prescribed learning activities such as attendance at lectures/practical, seminars, projects, etc. Credits are allocated to all the educational components of a study programme and indicate the quantity of work each component requires to achieve its specific objectives.

Evaluation is an important component of any teaching-learning process. The Institute gives emphasis on continuous evaluation with considerable freedom to the teacher in deciding the mode of evaluation of the students. The performance of the student is documented by a **grade** at the end of the semester. The grading scale ranks the students on a statistical basis. Therefore, statistical data on student performance is a prerequisite for applying the grading system.

2. Course Credits

In general a certain quantum of work measured in terms of **credits** is laid down as the requirement for a particular degree. The student acquires credits by passing courses every semester, the amount of credit associated with a course being dependent upon the number of hours of instruction per week in that course.

There are mainly two types of courses in the Institute - lecture courses and laboratory courses. Lecture courses consist of lecture (L) and tutorial (T) hours. Laboratory courses consist of practical (P) hours. The credit (C) for a course is dependent on the number of hours of instruction per week in that course, as given below:

- (1) 1h/week of lecture (L) or tutorial (T) = 1 credit
- (2) 2h/week of Practicals (P) = 1 credit
- (3) Credit (C) for a theory course = No. of hours of lectures per week +
No. of hours of tutorials per week = L + T
- (4) Credits (C) for a Laboratory course/Seminar/research work =
 $\frac{1}{2} \times$ No. of hours per week

Credits will be assigned to In-plant, Seminar, Projects and other mandatory course requirements also and these will be mentioned in the respective syllabi. There may be some non-credit requirements. A student is required to earn credits as mentioned in the syllabus.

3. Evaluation

3.1 The weightages of different modes of assessments shall be as under.

	In-Semester evaluation		End-Semester-Exam	Components of continuous mode
	Continuous mode	Mid Semester-Exam		
Theory	20%	30%	50%	Quizzes, class tests (open or closed book), home assignments, group assignments, <i>viva-voce</i> assignments, discussions
Practical	50%	-	50%	Attendance, <i>viva -voce</i> , journal, assignments, project, experiments, tests
Seminar/Research work			100%	Continuous evaluation not applicable, End semester evaluation will be based on written report evaluation and presentation in front of the external examiner within the Department

3.2. In-Semester Evaluation:

- (a) It is expected that the teacher would conduct at least two assessments (in any form as quizzes, tests, home work, group work etc) under the continuous mode in a Semester.
- (b) The teacher will announce at the beginning of the respective course the method of conducting the tests under the continuous mode and the assignment of marks
- (c) In-semester performance of all students should be displayed and sent to the academic office by the teacher at least 15 days before the end-semester examination.
- (d) For the theory courses, there will be one mid-semester test for each course to be held as per the schedule fixed in the Academic Calendar.
- (e) For mid –semester examinations in theory papers, duration of examination will be 1 hour for 3 credit courses and 2 hours for 4 credit courses

3.3. End-Semester examination:

- a) The semester end examination will cover the full syllabus of the course and will be conducted as per the Institutional time table at the end of each semester.
- b) For end –semester examinations in theory papers, duration of examination will be 1 hour for 3 credit courses and 2 hours for 4 credit courses
- c) For the end semester evaluation of seminar/research work, student will be expected to submit a written report and also make a presentation. The evaluation will be based on the quality of the written report and presentation.

3.4 Passes and Fail

- (a) The candidates who obtain 40% and more marks of the total marks of a course head shall be deemed to have **passed** the respective course head.
- (b) The candidates who obtain marks less than 40% of the total marks of a course head shall be deemed to have **failed** in the respective course head (**Grade FF**).

3.5 Grades:

(a) The performance of a student shall be documented by a **Letter grade**. Each letter grade has a **Grade point** associated with it. The Grades and Grade points shall be assigned to each head of passing and both will be indicated in the mark-list of the semester examination.

(c) The total marks (in-semester + end-semester) of a candidate in a subject head are converted into a letter grade, based on the relative (and sometimes the absolute) performance of the student.

Letter Grade	Grade Point
AA	10
AB	9
BB	8
BC	7
CC	6.5
CD	6
DD	5.5
EE	5

(d) For granting class, a grade point of 6.0 and above will be considered equivalent to First class.

(c) The grades to be allotted in the case of students who fail or do not appear at the end-semester examination shall be as under.

Letter Grade	Grade Point	Explanation
FF	0	The candidate fails in course head. The candidate will be allowed to take end-semester repeat or subsequent examinations as per rule.

XX		The candidate has not kept term for the course head due to attendance less than requisite. Further see 3.5(g) below. In the above cases, the candidate has to repeat the respective course by paying the fees.
I	0	The candidate has kept term for the course head, has taken all the internal examinations with satisfactory performance, but has failed to take the end-semester examination or repeat examination due to genuine reasons. The candidate will be allowed to take end-semester repeat or subsequent examinations as per rule.
FR	0	The candidate has exhausted all the permissible chances to clear the end-semester examinations. The candidate has to register for the respective semester again for all the subject heads or will be out of the respective degree course as per the rules.
DR	0	(i) The candidate hasn't participated in academic programme. (ii) The candidate has taken a drop for the subject head; - provided he/she intimates the same (i or ii) at least 7 days in advance of the commencement of the end-semester examination for the respective year.

(d) Grades **FF** and **I** are place-holders only and do not enter into CPI/SPI calculations directly. These grades get converted to one of the regular grades after the end-semester examination.

(e) A candidate with an **FR** grade is not eligible for any repeat examination in that course and has to re-register for that semester by paying the appropriate fees.

(f) **I** grade will not be continued beyond the permissible number of end-semester/repeat examinations.

(g) '**XX** Grade: The grade **XX** in a course is awarded if – (i) candidate does not maintain the minimum 75% attendance in the Lecture/Tutorial/Practical classes, (ii) candidate receives less than 20% of the combined marks assigned for continuous assessment and mid-semester examination, and (iii) candidate indulges in a misconduct/uses unfair means in the examination, assignments, etc., of a nature serious enough to invite disciplinary action in the opinion of the teacher.

(Note: Award of the **XX** grade in the case of g(iii) above shall be done by Disciplinary Action Committee (DAC)).

(h) The names/roll numbers of students to be awarded the **XX** grade should be communicated by the teacher to the Academic office as per academic calendar before the last date of submission of the application for end-semester examination.

3.6. Awarding the grades

The grading scale ranks the students on a statistical basis on the basis of the overall performance of the students of a given class in the given course head. Therefore, statistical data on students' performance is a prerequisite for applying the grading system. While assigning grades in a given course head, it is essential to know the **average marks (AM)** obtained by the students *who have passed the subject head* and the **highest marks (HM)** obtained in the *same subject head*.

3.6.1. If the **average marks (AM)** obtained by the students *who have passed the subject head* is <60%, the interval AM shall be awarded grade CC and the other grades shall be decided as follows:

(i) AA, AB, BB, and BC grades shall be decided between the AM and HM by dividing the range in equal intervals.

(ii) CD, DD and EE grades shall be decided between the AM and minimum marks required for passing the head (i.e. 40%) by dividing the range in equal intervals.

3.6.2. If the **average marks (AM)** obtained by the students *who have passed the subject head* is such that **60% ≤ AM < 70%**, the interval AM shall be awarded grade BC and the other grades shall be decided as follows:

- (i) AA, AB, BB grades shall be decided between the AM and HM by dividing the range in equal intervals.
- (ii) CC, CD, DD and EE grades shall be decided between the AM and minimum marks required for passing the head (i.e. 40%) by dividing the range in equal intervals.

3.6.3. If the **average marks (AM)** obtained by the students *who have passed the subject head* is **≥ 70%**, the interval AM shall be awarded grade BB and the other grades shall be decided as follows:

- (i) AA and AB grades shall be decided between the AM and HM by dividing the range in equal intervals.
- (ii) BC CC, CD, DD and EE grades shall be decided between the AM and minimum marks required for passing the head (i.e. 40%) by dividing the range in equal intervals.

4. SPI and CPI

(a) **Semester Performance Index (SPI):** The performance of a student in a semester is indicated by **Semester Performance Index (SPI)**, which is a weighted average of the grade points obtained in all the courses taken by the student in the semester and scaled to a maximum of 10. (SPI is to be calculated upto two decimal places.)

A Semester Grade Point Average (SGPA) will be computed for each semester as follows:

$$SGPA = \frac{\left(\sum_{i=1}^n c_i g_i \right)}{\left(\sum_{i=1}^n c_i \right)}$$

Where

‘n’ is the number of courses for the semester,

‘c_i’ is the number of credits allotted to a particular course, and

‘g_i’ is the grade-points awarded to the student for the course based on his performance as per the above table.

SGPA will be rounded off to the second place of decimal and recorded as such.

(b) **Cumulative Performance Index (CPI):** An up to date assessment of the overall performance of a student from the time he entered the Institute is obtained by calculating **Cumulative Performance Index (CPI)** of a student. The CPI is weighted average of the grade points obtained in all the courses registered by the student since he entered the Institute. CPI is also calculated at the end of every semester (upto two decimal places).

Starting from the first semester at the end of each semester (S), a Cumulative Grade Point Average (CGPA) will be computed as follows:

$$CGPA = \frac{\left(\sum_{i=1}^m c_i g_i \right)}{\left(\sum_{i=1}^m c_i \right)}$$

Where

‘m’ is the total number of courses from the first semester onwards up to and including the semester S,

‘c_i’ is the number of credits allotted to a particular course, and

‘g_i’ is the grade-points awarded to the student for the course based on his performance as per the above table.

CGPA will be rounded off to the second place of decimal and recorded as such.

(c) The CGPA, SGPA and the grades obtained in all the subjects in a semester will be communicated to every student at the end of every semester / beginning of the next semester.

(d) **When** a student gets the grade ‘FF’, or ‘I’ in any subject head during a semester, the SGPA and CGPA from that semester onwards will be tentatively calculated, taking only ‘zero’ grade point for each such ‘FF’ or ‘I’ grade. When the ‘FF’ grade(s) has / have been substituted by better grades after the repeat examination or subsequent semester examination, the SGPA and CGPA will be recomputed and recorded.

5. Repeat End-Semester Examination

5.1. For those candidates who fail in a subject head or are eligible for appearing at the repeat examination, **Repeat End-Semester Examination** will be conducted within one month from the declaration of the results of regular end-semester examination, as per **Regulation R.14**.

5.2. The marks obtained by candidates in the in-semester examinations (continuous assessment and Mid-Semester Examination) will be carried forward in such cases.

5.3. Grading the performance in the Repeat Examination: The grades will be assigned as per 3.5 and 3.6 above. However, for a candidate taking any repeat examination or subsequent regular semester examination or performance improvement examination shall be awarded **one grade lower** than that decided on the basis of the actual marks obtained; provided ‘EE’ grade obtained in such an examination shall remain ‘EE’. For reference see the table below.

Grade obtained in repeat or subsequent end-semester examination	Grade to be assigned	Grade point
AA	AB	9.0
AB	BB	8.0
BB	BC	7.0
BC	CC	6.5
CC	CD	6.0
CD	DD	5.5
DD	EE	5.0
EE	EE	5.0

5.4. Revaluation of end-semester and repeat examination: Candidate’s performance in these examinations will be displayed on proper notice board and after 3 days of such display the marks will be sent to the Academic Office. No revaluation of these examinations will be allowed.

6. Passing of a Semester examination

A candidate shall be declared as **‘PASSED’** any semester examination if he/she has

- Cleared all heads of passing by securing grades EE or higher in all the heads;
- Passed all the heads of passing such as project, seminar, training, etc as per the rules;
- Satisfactorily completed all the mandatory requirements of the course;
- paid all the Institute dues;
- No case of indiscipline pending against him/her.

7. Eligibility for the Award of a Degree

A candidate shall be declared eligible for the award of a degree, if he/she has cleared all the semester examinations as given in (6) above.

8. Allowed to keep terms (ATKT)

8.1 A candidate who has I grade in one or more heads of passing of an odd semester of an academic year shall be allowed to keep terms for the respective even semester.

8.2. A candidate shall be allowed to keep terms for the subsequent academic year if he/she has FF or I grades in not more than two heads of passing from all the heads of passing of the two terms of the previous academic year taken together. Such a candidate shall be declared as **FAILED, ATKT**.

9. Repeating a course

9.1 A student is required to repeat the course under the following situations:

- (a) A student who gets an **XX, FR, or DR** grade in a course; or
- (b) A student has exhausted all permissible chances to clear the course.

9.2 A candidate from first year who remains absent for the regular end-semester examination of a semester and the corresponding repeat examination for **ALL SUBJECTS** shall have to take fresh admission for the corresponding year; unless the candidate has dropped out / terminated from the course.

9.3 If a candidate at the Second, fails to pass any semester examination in not more than 4 consecutive examinations, including the repeat examinations, from the date of registering for the respective year, the candidate shall have to take readmission for the corresponding year again in which the failure has occurred, provided the course is not changed.

10. Improvement of performance

A candidate will be allowed to appear at the **entire examination** after the regular end-semester examination as per the respective rules to improve the performance. In such a case if the result of the examination repeated –

1. Is better than the previous one, the previous result shall be declared null and void; and
2. Is worse than the previous one, the result of the subsequent examination shall not be declared.
3. However, awarding of final grade will be made under the provision of sub clause 5.3 above.

11. Exit rules for poorly performing students

A candidate shall be excluded from a course under the following conditions:

- (a) If he/she fails to pass any semester examination of the any year of the course in not more than four consecutive attempts (Examination conducted by Institute) from the date of joining the course.
- (b) If he/she does not keep two consecutive terms without giving any reasonable justification (as prescribed by the institute) for doing so.
- (c) If a candidate fails to fulfill all the requirements of his/her respective degree within the prescribed period from the date of taking admission to the course, the candidate shall be excluded from the course.

12. Miscellaneous

- (a) Although CPI will be given in the Semester grade report, the final degree certificate will not mention any **Class** whatsoever.
- (b) Notwithstanding anything said above if a course is revised /restructured then transient provisions applicable at the time of revision /restructuring shall be applicable.

Department of Polymer & Surface Engineering
Four Semester
Master of Technology Degree Examination Syllabus
Surface Coating Technology

Semester I

No.		Course Code	Subjects	Hours/ week (L+T)	Marks	Credits
1	Core I	SCT 2101	Advanced Surface Coating Technology I	2+1	50	3
2	Core II	PST 2102	Structure Property Relationship in Polymers	2+1	50	3
3	Core III	PYT 2106	Physical Methods of Analysis	2+1	50	3
4	Elective I	PHT 2106	Research Methodology	2+1	50	3
5	Elective II	BST 2106	Intellectual Property Rights	2+1	50	3
6	Seminar	SCP 2103	Seminar & Critical Review of One Research Publication	6	50	3
7	Practical	SCP2104	Paint Processing Lab	6	50	3
8.	Research I	SCP 2105	Literature Review and Research on proposed research Topic	12	100	6
			TOTAL	39	450	27

Semester II

No.		Course Code	Subjects	Hours/week (L+T)	Marks	Credits
1	Core I	SCT 2201	Advanced Surface Coatings Technology II	2+1	50	3
2	Core II	SCT 2202	High Performance Coatings	2+1	50	3
3	Core III	PST 2203	High Polymer Chemistry	2+1	50	3
4	Elective I	SCT 25**	To be selected from pool	2+1	50	3
5	Elective II	SCT 25**	To be selected from pool	2+1	50	3
6	Practical	SCP 2204	Testing and Characterization of Coating Lab	6	50	3
7	Research II	SCP 2205	Laboratory Project work on proposed research Topic	18	150	9
			TOTAL	39	450	27

SEMESTER III

No.	Course Code	Course	Hours/Week	Marks	Credits
1	SCP 2301	In Plant Training	40(15 Weeks)	450	30
	TOTAL		40	450	30

SEMESTER IV

No.	Course Code	Course	Hours/Week	Marks	Credits
1	SCP 2401	Research Thesis and Open Defence	40	450	30
	TOTAL		40	450	30

SEM III and SEM IV will be conducted at the end of IV Semester

Total credits

Total credits 39(Sem I) + 39 (Sem II) = 78

Total credits for semesters III and IV are 30 + 30 = 60

SEMESTER I

Code & Title of the Course	SCT 2201.Advanced Surface Coating Technology I
Marks	50
Number of Hours per Week	2+1
Credits	3
Class	M Tech
Semester	I

Sr. no.	Topics	Hrs.
1	Alternate to toxic harmful and eco-damaging materials like solvents binders and additives.	4
2	Bio-source materials for binders and additives	4
3	Energy management paints-Heat insulation paint, Heat reflective paint	4
4	Electrophoretic paint Self deposition paint Metal coating-Zn ,Al	4
5	Inorganic binders	3
6	Developments in pigments for typical functional applications. Concept of ecofriendly pigments in surface coatings. Developments in methods of testing.	6
7	Newer developments in chemistry and synthesis of surface coating binders such as epoxies, urethanes, acrylics, silicones and others.	6

Course Outcomes

- 1.Student will able to tell environmental concern toxicity handling hazards of solvents organic and inorganic binders additives used in paint industry
- 2.Student will get the knowledge of Bio-source materials for binders and additives
- 3.Student will have ability to formulate paint systems for heat sensitivity reflection metal containing paint system etc
- 4.Student will get the knowledge of functional pigment eco-friendly pigments and testing methods
- 5.Ability to design and formulate and synthesize newly modified binders.

Text/ Source Books

1. Introduction to Paint Chemistry by Turner
2. Pigment Hand Book Part 1, 2,3 by Patton
3. Encyclopedic Hand book of Emulsions Technology by Sjoblom
4. Paint Film Defects by Hess
5. Industrial Organic Pigments by W. Herbst
6. High performance pigments by Huge M. Smith
7. Application properties of Pigments by A. Karnik

8. Advances in surface coating technology: an international conference, London, 13-15 February, [1978], Volume 2
9. Coatings formulation: an international textbook by Bodo Müller, Ulrich Poth
10. Surface Coatings: Raw materials and their usage by Oil and Colour Chemists' Association

Code & Title of the Course	PST 2202 Structure Property Relationship in Polymers
Marks	50
Number of Hours per Week	2+1
Credits	3
Class	M Tech
Semester	I

Sr no.	Topic	Hrs.
1	Atomic Packing and Structure, Consequences of Packing Effects of atoms types of bonds, bond dissociation energy and functional groups on properties of polymers. Interchain and Intrachain Forces	4
2	Configuration and conformation Polymer chain flexibility Effect of molecular orientation on mechanical properties ,Molecular mass heterogeneity and structure properties, Intermolecular orders: Amorphous, crystalline and oriented forms of polymers, crystallinity in polymers, factors affecting crystallinity Polymer morphology and its effect	6
3	Polymers solutions: thermodynamics of dissolution, factors effecting dissolution and swelling of polymers, phase equilibrium of polymer-solvent systems, polymer solution, Florry-Huggins theory	5
4	Rhelogical Properties of Polymer Melts and Polymer Solution	4
5	Thermal properties of polymers: fire retardant polymers, factors affecting glass transition (T _g) temperature, heat stability etc. with case studies	3
6	Degradation and stabilization: various stresses acting on polymers and their influence, method of improving the stability of polymers with case study	3
7	Mechanical Electrical Optical magnetic acoustic properties of polymers	5

Course outcomes

1. Ability to understand the general structural features of polymers, Functional groups
2. Ability to understand the Configuration and conformation and structure properties of polymers and Molecular mass heterogeneity and structure properties
3. Ability to understand the thermodynamics and factors affecting dissolution
4. Ability to understand Rheological properties of polymers
5. Ability to understand the Thermal and degradation/stabilization of polymers and to analyses the respective case studies
6. Ability to understand Mechanical Electrical Optical magnetic acoustic properties of Polymers and their structural relationship.

Text/Source Books

1. Polymer Structure, Properties and application, R.D. Deanin, American Chemical Society, 1974.
2. Relating Materials, Properties to Structure; Handbook and Software for Polymer calculations and Materials Properties, D. J. David and Ashok Mishra, Technical Publishing Compony, Inc, 1999.
3. Properties of Polymer; Correlations with Chemical Structures and their numerical Estimation and Predication from Additive Group Contribution van Krevelen, Elsevier Publication Company, 1990.
4. Relating Materials Properties to structure, D. J. David, Technical Publishing Company Inc, 1999.
5. Polymer Chemistry, C. E. Carrsar, Marcel Dakker Inc, 2003.
6. Physical chemistry of Polymers, A. Tager, Mir Publishers, 1978.
7. Polymer Association Structures M. A. EL-Nokally, American Chemical Society, 1989.
8. Polymer Solutions; Introduction to Physical Properties, Teraoka, Iwao, John Wiley and Sons. Inc, 2002.
9. Polymer Chemistry; An Introduction, M. P. Stevens, Oxford University Press, 1990.

Code & Title of the Course	PYT 2106 Physical Methods of Analysis
Marks	50
Number of Hours per Week	2+1
Credits	3
Class	M Tech
Semester	I

Sr.No.	Topics	Hrs.
1.	Fourier Transform Infrared Spectroscopy: Molecular vibrations, frequency shifts associated with structural changes, basic theory of FTIR spectroscopy, interferogram, digitization of interferogram, data points collection, instrumentation and advantages of FTIR spectrophotometry, qualitative and quantitative analysis using infrared spectrophotometry	5

2.	Ultraviolet and visible spectrophotometry: Electronic transitions, spectrum, shift of bands with solvents, isolated double bonds, conjugated dienes, carbonyl compounds, aromatic and hetero-aromatic compounds, application in pollution control and chemical industry	5
3.	Nuclear Magnetic Resonance: Basic principles of NMR phenomenon, relaxation processes, spin-spin interaction, chemical shifts, interpretation of NMR spectra, correlation - hydrogen bonds to carbon and other nuclei, instrumentation, continuous and pulsed NMR, carbon-13 NMR.	5
4.	X-ray Diffraction: Crystal geometry and structural determination, Bragg's law of X-ray diffraction, powder method, X-ray spectrometers - wide and small angle diffractometers, chemical analysis by X-ray diffraction	2
5.	Particle size analysis: Particle size, sampling, conventional techniques of particle size measurement, light scattering, particle size measurement by light scattering techniques, dynamic light scattering (DLS), fibre-optic dynamic light scattering (FDLS)	5
6.	Chromatography: Basic theory of separation, efficiency, resolution, liquid chromatography, high performance liquid chromatography (HPLC), gas chromatography - columns and detectors, qualitative and quantitative analysis	5
7.	Mass Spectroscopy: Basic principles, ionization of a molecule on electron impact, fragmentation processes in organic compounds, interpretation of mass spectra, molecular weight, molecular formula, instrumentation - different types of ionization sources and magnetic analysers	3

Reference books:

1. Fundamentals of Molecular Spectroscopy - C. Banwell and E. McCash
2. Instrumental Methods of Analysis - H. H. Willard, I. M. Merritt and J. A. Dean
3. Dye Lasers - F. P. Schafer
4. Infrared Spectra of Complex Molecules - L. J. Bellamy
5. Fundamentals of Surface and Thin Film Analysis - L. C. Feldman and J. W. Mayer
6. X-ray Structure Determination - G. H. Stout and I. H. Jensen
7. High Resolution NMR Spectroscopy - E. D. Becker
8. Nuclear Magnetic Resonance Spectroscopy—RXHarris
9. Physical Methods - R. S. Drago
10. Advances in Electrochemical Science and Engineering - I. Gerischer and C. W. Tobias (eds.)

Code & Title of the Course	PHT 2101 Research Methodology
Marks	50
Number of Hours per Week	2+1
Credits	3
Class	M Tech
Semester	I

Sr.No.	Topic	Hrs.
1.	<p>Research</p> <p>Meaning of Research, Purpose of Research, Types of Research (Educational, Clinical, Experimental, Historical, Descriptive, Basic applied and Patent Oriented Research) – Objective of research- Literature survey – Use of Library, Books, & Journals – Medline – Internet, getting patents and reprints of articles as sources for literature survey. Selecting a problem and preparing research proposal for different types of research mentioned above.</p> <p>Methods and tools used in Research</p> <ul style="list-style-type: none"> • Qualitative studies, Quantitative Studies • Simple data organization, Descriptive data analysis • Limitations and sources of Error • Inquiries in form of Questionnaire, Opinionnaire or by interview • Statistical analysis of data including variance, standard deviation, students ‘t’ test and annova, correlation data and its interpretation, computer data analysis 	4
2.	<p>Documentation</p> <ul style="list-style-type: none"> • “How” of Documentation • Techniques of Documentation • Importance of Documentation • Uses of computer packages in Documentation 	4
3.	<p>The Research Report / Paper writing / thesis writing</p> <ul style="list-style-type: none"> • Different parts of the Research paper <ol style="list-style-type: none"> 1. Title – Title of project with author’s name 2. Abstract – Statement of the problem Background list in brief and purpose and scope 3. Key-words- 4. Methodology-Subject, Apparatus / Instrumentation, (if necessary) and procedure 	4

4.	<p>Results – tables, Graphs, Figures, and statistical presentation</p> <p>Discussion – Support or non- support of hypothesis – practical & theoretical implications, conclusions</p> <p>Acknowledgements</p> <p>References</p> <p>Errata</p> <p>Importance of spell check for Entire project</p> <p>Use of footnotes</p>	5
5.	<p>Presentation (Specially for oral)</p> <ul style="list-style-type: none"> • Importance, types, different skills • Content of presentation, format of model, Introduction and ending • Posture, Gestures, Eye contact, facial expressions stage fright • Volume- pitch, speed, pauses & language • Visual aids and seating <p>Questionnaire</p>	5
6.	<p>Protection of patents and trade marks, Designs and copyrights</p> <ul style="list-style-type: none"> • The patent system in India – Present status Intellectual property Rights (IPR), Future changes expected in Indian Patents • Advantages • The Science in Law, Turimetrics (Introduction) • What may be patented • Who may apply for patent • Preparation of patent proposal 	5
7.	<p>Sources for procurement of Research Grants</p> <p>Industrial- Institution Interaction</p> <p>- Industrial projects – Their feasibility reports</p>	3

Reference books:

1. Research in Education – Johan V. Best James V. Kahn
2. Presentation skills- Michael Halton- Indian Society for Institute Education
3. A Practical Introduction to copy right – Gavin Mcfarlane
4. Thesis projects in Science and Engineering – Richard M. Davis
5. Scientists in legal system – Ann labor science
6. Theses and Assignment writing – Jonathan Anderson
7. Writing a technical paper- Donald Menzel
8. Effective Business Report writing – Leland Brown
9. Protection of Industrial property rights- Purushottam Das and Gokul Das
10. Spelling for the million – Edna furmess
11. Preparing for publication – King Edwards Hospital fund for London
12. Information technology – The Hindu speaks
13. Documentation – Genesis & Development 3792
14. Manual for evaluation of Industrial projects – United Nations
15. Manual for the preparation of Industrial feasibility studies

Code & Title of the Course	BST 2106 Intellectual Property Rights
Marks	50
Number of Hours per Week	2+1
Credits	3
Class	M Tech
Semester	I

Sr.No.	Topic	Hrs.
1.	General Introduction to IPR and Essentials of IP management <ul style="list-style-type: none"> • History of Indian and International Patent System and International Treaties • Introduction to Trademark filing in India • Introduction to Design filing in India • Introduction to Geographical Indication filing in India • Introduction to Indian Patent Law • Assessment of Invention by documentation and Search • Analysis of R&D Activity for Patentability 	10
2.	Techno-legal requirements for filing of Patent Drafting of Patent Specification	4
3.	Patent Prosecution in India Patent Prosecution at International level (Convention and PCT Routs) Agreements & Contracts for Patent Management and drafting of same Infringements for Patent Commercialisation Search and Patentability Opinion	12
4.	Case Studies: Cases of Herbal medicines, biomolecules, agrochemicals, and bulk drugs, oil and textile in India and abroad before Patent Office/ Courts	4

Reference books:

1. Intellectual Property Rights By Khushdeep Dharni, Neeraj Pandey
2. Indian Patent Law And Practice By K.C. Kankanala (Oxford India) 2013 Edition

Code & Title of the Course	SCP 2103 Seminar and Critical Review of One Research Publication
Marks	50
Number of Hours per Week	6
Credits	3
Class	M Tech
Semester	I

Sr.No.	Topic	Hrs.
1.	Student will be required to prepare critical reviews of selected topics in Chemical Technology and Allied subjects and submit in the form of standard typed report. The student will also be required to make an oral presentation of the review.	15
2.	Student will be required to review single research publication either published as decided by the faculty advisor. In general a written Critical Reviews report needs to be submitted in the form of standard typed report. The student will also be required to make an oral presentation of the review	15

Course Outcomes:

1. Survey literature related to the given topic (K3)
2. Analyze the reported outcomes and classify the work under key categories (K3)
3. Write a technically correct report as per the suggested guidelines and present the seminar work (K4)

Syllabus:

The Seminar work is concerned with a detailed and critical review of an area of interest to Surface Engineering. Typically, the report should contain and will be evaluated based on the following points:

- (a) Introduction: 2 pages maximum,
 - (b) Exhaustive review of literature (including figures): 10 – 12 pages: 50% Weightage
 - (c) Critical analysis of the literature and comments on the analysis Critical analysis should also contain quantitative comparison of observations, results, and conclusion amongst the various papers.
2. Two typed copies of the report on thesis size bond paper (297 mm x 210 mm) are to be submitted to Coordinator on **time to be decided by the coordinator**. The detailed timetable for the presentation would be communicated.
 3. The report should be prepared using the Times Roman font (size 12) using 1 1/2 spacing leaving 1-inch margin on all sides producing approximately 29 lines per page. The report should be typed on one side of the paper and need not be bound in a hard cover binding. Figures and tables should be shown as a part of the running text. Each figure should be drawn inside a rectangular box of 12 cm width and 10 cm height. The figures must be sufficiently clear and hand drawn figures will be acceptable. Particular care must be taken if

a figure is photocopied from source. Each figure must have a sequence number and caption below. Each table must have a sequence number and title at the top.

4. Name of the student, title of the problem and year of examination must be indicated on the top cover. **THE NAME OF THE SUPERVISOR (ONLY INITIALS) MUST APPEAR ON THE BOTTOM RIGHT CORNER OF THE TOP COVER.**
5. The report must be precise. All important aspects of the topic should be considered and reported. **The total number of pages, including tables, figures, and references should not exceed 30.** Chapters or subsections need not be started on new pages, while getting the report typed.
6. Typographical errors in the report must be corrected by the student. The student will be discredited for any omission in the report. All the symbols used in the text should be arranged in an alphabetical order and given separately after conclusions.
7. The list of references should be arranged in alphabetical order of the names of authors. In the text, the reference should be cited with author's name and year. (author – date style) For example:
 - (i) The flow pattern in gas-liquid-solid fluidized bed has been reported in the published literature (Murooka et al., 1982).

OR

- (ii) Murooka et al. (1982) have measured flow patterns in gas-liquid-solid fluidized beds. The title of the article should also be included. The references must be given in the following standard format.
 - (a) Format for listing references of articles from periodicals: Murooka S., Uchida K. And Kato Y., "Recirculation Turbulent Flow of Liquid in Gas-Liquid-Solid Fluidised Bed", J. Chem. Engg. Japan, 15, 29-34 (1982).
 - (b) Format for listing references of Books: Constant R.F., "Crystallization, Academic Press, New York, pp. 89-90, 1968.
 - (c) Format for listing Thesis: Niranjan K., "Hydrodynamic and Mass Transfer Characteristics of Packed Columns", Ph.D. (Tech.) Thesis, University of Mumbai, 1983.
 - (d) Format for listing references of Patents in Chemical Abstracts: Cananaush R.M., U.S.Patent 2,647,141, Cf. C.A. 48, 82636 (1954).
 - (e) Format for listing Handbooks, Tables, Symposia etc.: Kumar R and Kuloor N.R., "Formation of Drops and Bubbles", in Advances in Chemical Engineering, Vol.8, T.B. Drew et.al. (Eds.) New York, Academic Press, pp.256-364 (1970).
 - (f) Format for listing Private Communications and other categories: Sharma, M.M., Private Communication (1984).
8. Consistency of units should be maintained in the written report. SI systems should be used. [For SI system – Ref: Ind. Chem. Engr., 24, 32, 3 (1983)]. Units used in the literature (if not SI) should be correctly converted.
9. The time allotted for the oral presentation of seminar is 20 minutes: additional 10 minutes are provided for questions and answers.
10. **INCOMPLETE AND CARELESSLY WRITTEN REPORT IS LIABLE TO BE REJECTED.**
11. The last date for submission will NOT be extended on any grounds whatsoever.
12. There must not be any acknowledgment about the guidance by the faculty in the Seminar.

13. The Seminar will be evaluated on the basis of (i) rational approach to the problem, ii) correctness and completeness of the written text and iii) performance in the oral presentation.
14. Word-to-word copying from the published article is not permitted. Flowery language is not to be used.

The submitted report will be evaluated by the research guide and an external examiner from the Department/Industry based on the presentation made by the candidate. A suitable combination of the marks for report and presentation will be considered for the final evaluation.

Code & Title of the Course	SCP 2104 Paint Processing Lab
Marks	50
Number of Hours per Week	6
Credits	3
Class	M Tech
Semester	I

Sr no.	Topics	Hrs./week
1	Paint processing using Ball mill, attritor mill, Tripple roll mill and high speed disperser etc	6
2	Formulation of Primers, zinc rich epoxy	
3	Formulations for enamels, Water based paint formulations	
4	Anti-fouling coatings, Paints for marine environments, vinyl paints Automotive protection products, paints.	
5	Formulation of sealants and adhesives	
6	Metallic paints, Powder coatings, Coil coatings.	
7	Wood finishing, Strippable coatings, lacquers	
8	Plastic Emulsion Paint And Distemper	
9	Road marking paints, Cement paints	

Course Outcomes

- CO 1: To be able to understand various methods for preparation of paints
- CO 2: Understanding of basic ingredients required for designing of various paints (solvent based and water based)
- CO 3: The student should be able to design the recipe of paint and effect of various ingredients on its properties
- CO 4: ability to perform practical experiments including application of paint and evaluation of film properties
- CO 5: To decide and optimize the dosage of pigment and binder to maximize the performance properties of paints

Text/ Source Books

1. Polymer Chemistry: A Practical Approach (The Practical Approach in Chemistry series) 1st Edition Fred J. Davis Oxford University Press 2004
2. Basics of Paint Technology Part I, V. C. Malshe.
4. Polymer Science by Gowariker, John Wiley and Sons 1986.
5. Resins for Surface Coatings, Polyurethanes Polyamides Phenoplasts Aminoplasts Maleic Resins (Waterborne & Solvent Based Surface Coatings Resins & Applications) (Volume III) Volume III Edition
6. Resins for Surface Coatings, Volume 1 2nd Edition, Resins for Surface Coatings: Acrylics and Epoxies 2nd Edition by H. Coyard (Author), P. Deligny (Author), N. Tuck (Author), P. K. T. Oldring (Editor)
7. Basics of Paint Technology Part II, Part 2, V. C. Malshe, Prakash C. Malshe, 2008 - Coatings - 624 pages
8. Principles of polymerization, G. Odian, Wiley – Interscience (1981)
9. Outlines of Paint Technology Hardcover – December 1, 2000 by Morgan (Author)

Code & Title of the Course	SCP 2105 Research I
Marks	100
Number of Hours per Week	12
Credits	6
Class	M Tech
Semester	I

Sr.No.	Topic	Hrs.
1.	Literature Review and Research on proposed research Topic	30

Course Outcomes:

1. Analyze existing literature for research topic and develop detailed plan of experiments/simulations (K3)
2. Systematically perform experiments/modeling activity to accomplish the set objectives (K4)
3. Critically analyse the results and write a technically correct report as per the suggested guidelines and present the work (K4)

Details:

The Research project I is concerned with detailed literature review of the assigned research area in consultation with the guide, developing an experimental/simulation protocol and initiate the actual research work. Based on the outcomes of the candidate is expected to submit a report as per similar guidelines provided for SCP 2103 above which will be evaluated by the research guide and an external examiner from the Department/Industry based on the presentation made by the candidate. A suitable combination of the marks for report and presentation will be considered for the final evaluation.

SEMESTER II

Code & Title of the Course	SCT 2201.Advanced Surface Coating Technology II
Marks	50
Number of Hours per Week	2+1
Credits	3
Class	M Tech
Semester	II

Sr. No.	Topics	Hrs.
1	Microencapsulation- Sustain release, control release, self healing	3
2	Smart coatings-Temperature sensor pressure sensor coatings chemical sensor coatings, Soft feel coatings anti damping coatings anti efflorescence coatings	9
3	Fire retardant coatings, Powder coatings radiation cure coatings	3
4	Self stratified coatings Anti microbial coatings anti corrosive coatings	3
5	Developments in high solids, waterborne and such eco-friendly coating compositions. Various functions and importance of ingredients used in the formulations.	9
6	Advances in methods of application and film formation of surface coatings.	3

Course Outcomes

1. Ability to design develop formulate self healing sustain release coatings
2. Ability to develop and formulate smart coatings
3. Ability to design develop formulate Fire retardant coatings, Powder coatings radiation cure coatings
4. Ability to design develop formulate, eco-friendly aspect of high solids coatings
5. Ability to recommend newer application of coating system

Text/ Source Books

- 1) Introduction to Paint Chemistry by Turner
- 2) Pigment Hand Book Part 1, 2,3 by Patton
- 3) Encyclopedic Hand book of Emulsions Technology by Sjoblom
- 4) Paint Film Defects by Hess
- 5) Microencapsulation Technology for Corrosion Mitigation by Smart Coatings by Jerry Buhrow
- 1) High performance pigments by Huge M. Smith
- 2) Application properties of Pigments by A. Karnik
- 3) Advanced Surface Coatings: A Handbook of Surface Engineering by D. S. Rickerby, A. Mathews

- 4) Coatings technology handbook by Arthur A. Tracton
- 5) Paint and coatings: applications and corrosion resistance by Philip A. Schweitzer
- 6) Paints, coatings, and solvents by Dieter Stoye, Werner Freitag

Code & Title of the Course	SCT 2202.High Performance Coatings
Marks	50
Number of Hours per Week	2+1
Credits	3
Class	M Tech
Semester	II

Sr. No.	Topics	Hrs.
1	Coatings for off shore structure,Coatings for chemical plant	5
2	Anti carbonation coating,pipe line coatings antireflective coating wind turbine coating	10
3	Powder coatings and other high performance coatings & their importance, polymers used in powder coatings	10
4	Coatings for electronics	5

Course outcomes

1. Ability to design develop formulate chemical resistant coatings
2. Ability to design develop formulate anti carbonation and wind turbine coatings
3. Ability to design develop formulate, environmental aspects of powder coatings
4. Ability to design develop formulate, environmental and economical aspects of coatings in electronics

Text/ Source Books

1. A Guide to High-performance Powder Coating by Bob Utech
2. User's Guide to Powder Coating, Fourth Edition by Nicholas Liberto
3. Beginning Powder Coater's Handbook: An Introduction to Powder Coating by Tracy Norris
4. High Performance organic coating by A.S. Khanna,Woodhead publishing

Code & Title of the Course	PST 2105 High Polymer Chemistry
Marks	50
Number of Hours per Week	2+1
Credits	3
Class	M Tech
Semester	II

Sr. no.	Topics	Hrs.
1	New methods of synthesis of polymers like atom transfer polymerization, RAFT	5
2	Plasma polymerization	2
3	Group transfer polymerization	3
4	Nitroxide mediated polymerization	2
5	Solid state polymerization	3
6	Phase transfer polymerization	2
7	Metallocene catalysts for polymerization of polyolefins	3
8	Hyperbranched polymers	2
9	Healable polymers	2
10	Semiconducting polymers	2
11	Anionic and cationic polymerization	4

Course Outcomes

1. Student should understand the newer methods of synthesis, chemistry, mechanisms advantages and disadvantages, environmental concern of CRP
2. Student should understand the newer methods of synthesis, chemistry, mechanisms advantages and disadvantages, environmental concern of Plasma Polymerization and GTP
3. Student should understand the newer methods of synthesis, chemistry, mechanisms advantages and disadvantages, environmental concern of SSP and phase transfer polymerization
4. Student should understand the newer methods of synthesis, chemistry, mechanisms advantages and disadvantages, environmental concern, structure property relationship of catalyst used in polyolefines manufacturing.
5. Able to understand chemistry synthesis, mechanism types properties and applications of Hyper branched healable and semiconducting polymers.

Textbooks/Sourcebooks:

- 1) Encyclopedia of Polymer Science and Technology, Johan Wiley and Sons, Inc 1985.
- 2) Encyclopedia of Polymer Science and Engineering, Johan Wiley and Sons, Inc 1988.
- 3) Polymer Chemistry by Malcolm P. Stevens, Oxford University Press, Inc, 1990.
- 4) Introduction to Polymer Science and Technology by H. S. Kaufman and J. J. Falcetta, Wiley – Interscience Publication, 1977
- 5) Handbook of Polyethylene, A. J. Peacock, Marcel Dakker Inc, 2000
- 6)
- 7) R.P. Brown, Hand Book of Plastics Test Methods, George Godwin Ltd., London, 1981.
- 8) Analysis & Testing by Crompton.

- 9) J.S.Anand, K.Ramamurthy, K.Palanivelu how to identify Plastics by Simple Methods
- 10) G.C.Lves, J.A.Mead, M.M.Riley, Hand Book of Plastics Test Methods, The Plastics Institute,
- 11) Frank T.Traceski, Specifications & Standards for Plastics & Composites, ASM International, Metals Park, OH, 1990.
- 12) J.Hasiam, H.A. Willis, Identification & Analysis of Plastics, London Iliffe Books Ltd., New Jersey,

Code & Title of the Course	SCP 2204 Testing and Characterization of Coatings Lab
Marks	50
Number of Hours per Week	6
Credits	3
Class	M Tech
Semester	II

Sr. no.	Topics	Hrs./week
1	NVM, Viscosity, WPL, Grind, Hiding, Drying Time, Scratch Hardness, Impact Test, Flexibility, Gloss Dry Film Thickness	6
2	Acid Alkali, and water Resistance, Adhesion As per IS101, Corrosion Resistance By Salt Spray And Humidity Cabinet	
3	Partical size analysis of pigments, Accelerated weathering of paints Evaluation and testing of Synthetic Enamel, Primer, Emulsion paint, Intermediate Coat.	
4	Rheology of Paint system, Colour Matching of Synthetic Enamel, Plastic emulsion paint and distemper	
5	Thermal study of Coatings using DSC TGA DMTA	
6	Molecular weight determination using GPC	
7	Limiting oxygen index, Weather resistance and Permeability Zeta Potential	

Course Outcomes

CO 1: Ability to conduct various experimental tests for evaluation of physical, chemical, mechanical and optical rheological properties of paint.

CO 2: To be able to perform shade matching for various paints.

CO 3: To be able to use various methodologies and skills for evaluating performance properties of paints

CO4. Use/select analytical and physical testing equipment to carry out suitable experiments and Ability to analyze and interpret data, process parameters and characterize additives and polymers within realistic constraints of the experiment K2 K4 K6

Textbooks/Sourcebooks:

1. Introduction to Paint Chemistry by Turner
2. Pigment Hand Book Part 1, 2,3 by Patton
3. Encyclopedic Hand book of Emulsions Technology by Sjoblom
4. Paint Film Defects by Hess

Code & Title of the Course	SCP 2205 Research II
Marks	150
Number of Hours per Week	18
Credits	9
Class	M Tech
Semester	II

Course Outcome:

1. Systematically perform experiments/modeling activity to accomplish the set objectives (K3)
2. Critically analyse the results and present them in coherent manner in the form of graphs, tables etc. (K4)
3. Write a technically correct report as per the suggested guidelines and present the work (K4)

Details:

This would be concerned with the continuation of the research project executed in the first semester and the exact work plan will be decided in consultation with the research guide. At the end of the project, the candidate is expected to submit a report as per similar guidelines provided for SCP 2105 above which will be evaluated by the research guide and an external examiner from the Department/Industry based on the presentation made by the candidate. A suitable combination of the marks for report and presentation will be considered for the final evaluation.

ELECTIVES (Semester I & II)
(These are open for offer to students of other disciplines)

Code & Title of the Course	SCT 2501. Industrial Coatings*
Marks	50
Number of Hours per Week	2+1
Credits	3
Class	M Tech
Semester	

Sr. no.	Topics	Hrs
1	Coatings required for specific industries and their formulations, testing and specifications. Industrial coatings such as 1) Appliance Finishes 2) Automotive finishes	10
2	Coatings required for specific industries and their formulations, testing and specifications. Industrial coatings such as 1) Coil Coatings 2) Can Coatings 3) Aircraft Coatings	10
2	Paints for water proofing etc. formulation testing and specifications thereof.	10

Course Outcomes

1. Student will able to formulate paint for appliances and industrial coating.
2. Student will able to test the coating for industrial application.
3. Student will able to formulate paint for can coating.
4. Student will able to formulate paint for coil coating.
5. Student will able to formulate water proofing chemicals and can test them.

Text/ Source Books

1. BASF handbook on basics of coating technology by Artur Goldschmidt, Hans-Joachim Streitberger.
2. European coatings handbook By Thomas Brock, Michael Groteklaes, Peter Mischke
3. UV coatings: basics, recent developments and new applications By Reinhold Schwalm
4. Principle & Paint Formulation, R. Woodbroidge (Ed.) – 1991.

Code & Title of the Course	SCT 2502. Insulating Coating
Marks	50
Number of Hours per Week	2+1
Credits	3
Class	M Tech
Semester	

Sr. no.	Topics	Hrs
1	Fundamentals of electrical insulations. Classification of polymeric electrical insulation, structural requirements for insulation and properties of polymeric electrical insulation.	10
2	Various types of polymers used in electrical insulation, formulation principles, effect of ingredients in formulation, other insulations-thermal, aquatic and vibrational, application methods for electrical insulation	15
3	testing of electrical insulation by various standard methods.	5

Text/ Source Books

1. Additives for plastics handbook by John Murphy
2. Electrical insulation in power systems by N. H. Malik, Nazar Hussain Malik, A. A. Al-Arainy, Mohammad Iqbal Qureshi
3. Selection of polymeric materials: how to select design properties from different material by E. Alfredo Campo
4. Expanding monomers: synthesis, characterization, and applications by Rajender K. Sathir, Russell M. Luck

Code & Title of the Course	SCT 2503. Corrosion Science and Corrosion Prevention
Marks	50
Number of Hours per Week	2+1
Credits	3
Class	M Tech
Semester	

Sr. no.	Topics	Hrs
1	Fundamentals of corrosion phenomenon. Various types of corrosion. Methods of corrosion prevention and control.	10
2	Polymers used in corrosion prevention, corrosion inhibitors and various methods of corrosion inhibition.	10
3	Treatment of metal surface for corrosion protection. Pigments pigmented coatings, inorganic coatings.	5
4	Testing and specifications.	5

Text/ Source Books

1. Corrosion and protection by Einar Bardal
2. Electroactive polymers for corrosion control by Peter Zarras, John D. Stenger-Smith, Yen Wei
3. Corrosion prevention by protective coatings by Charles G. Munger
4. Corrosion of Polymers and Elastomers by Philip A. Schweitzer
5. Handbook of conducting polymers, Volume 1 edited by Terje A. Skotheim, John R. Reynolds

Code & Title of the Course	SCT 2504 Powder Coating
Marks	50
Number of Hours per Week	2+1
Credits	3
Class	M Tech
Semester	

Sr. no.	Topics	Hrs
1	Powder coatings and importance there of, polymers used in powder coatings, thermoplastic. Powder coatings based on vinyls, polyolefins, nylons, polyesters etc.	10
2	Thermosetting powder coatings based on epoxy, urethanes, acrylics etc.	5
3	Curing reactions, monitoring of curing process, crosslinkers used in thermosetting powder coating.	5
4	Industrial thermoplastic and thermosetting powder coatings, parameters influencing powder coating properties thermosetting powder coatings, parameters influencing powder coating properties, technology of production of powder coating, application techniques, newer developments.	10

Text/ Source Books

1. Paint and Surface Coatings by Lambourne and Strivens
2. Organic Coatings Science and Technology by Zeno Wicks et al
3. Surface Coatings Science and Technology by Swaraj Paul
4. Introduction to Paint Chemistry by Turner
5. Pigment Hand Book Part 1, 2,3 by Patton
6. Encyclopedic Hand book of Emulsions Technology by Sjoblom
7. Paint Film Defects by Hess
8. Industrial Organic Pigments by W. Herbst
9. High performance pigments by Huge M. Smith
10. Application properties of Pigments by A. Karnik
11. Basics of Paints Technology by V.C.Malshe
12. Polymer Structure, Properties and application, R.D. Deanin, American Chemical Society, 1974.
13. Relating Materials, Properties to Structure; Handbook and Software for Polymer calculations and Materials Properties, D. J. david and Ashok Mishra, Technical Publishing Componey, Inc, 1999.
14. Properties of Polymer; Correlations with Chemical Structures and their numerical Estimation and Predication from Additive Group Contribution van Krevelen, Elsevier Publication Company, 1990.

15. Relating Materials Properties to structure, D. J. David, Technical Publishing Company Inc, 1999.
16. Polymer Chemistry, C. E. Carrshar, Marcel Dakker Inc, 2003.
17. Physical chemistry of Polymers, A. Tager, Mir Publishers, 197
18. Printing ink Formulations principles by Ronal Todd
19. Text book of Polymer Science by Billmeyer, John Wiley ans Sons 1984.
20. Encyclopedia of Polymer Science and Technology, Johan Wiley and Sons, Inc 1965.
21. Encyclopedia of Polymer Science and Engineering, Johan Wiley and Sons, Inc 1988.
22. Polymer Chemistry by Malcolm P. Stevens, Oxford University Press, Inc, 1990.
23. Introduction to Polymer Science and Technology by H. S. Kaufman and J. J. Falcetta, Wiley – Interscience Publication, 1977

Code & Title of the Course	SCT 2505. Environment friendly Coatings*
Marks	50
Number of Hours per Week	2+1
Credits	3
Class	M Tech
Semester	

Sr. no.	Topics	Hrs
1	Types environment friendly coatings. Water borne coatings, high solid coatings, powder coatings. Techniques of preparation.	5
2	Fundamentals of emulsions. Functions of ingredients in emulsion polymers, functions and importance of surface active agents	10
3	Various types of polymers used in water borne coatings. Solubilizations of binders in water.	5
4	Application methods & rheology, issues related to safety. Testing and characterization coatings etc.	10

Course Outcomes

1. Student will able to formulate paint for high solid coating, water borne coating and powder coating.
2. Student will able to understand basics of emulsions and techniques.
3. Student will able to understand raw materials for water borne system and solublizations of binders.
4. Student will able to understand rheology of paint and testing, characterization of paint.

Text/ Source Books

1. Outline of paint technology, W.M. Morgans (3rd Edition – Recently CBS Publishers.
2. Paints, Coatings and Solvents, Dieter Stage (ED.) – 2nd Edition – Wernon Freitag Ltd., (Eds).

3. Principle & Paint Formulation, R. Woodbroidge (Ed.) – 1991.
4. Performance enhancement in coatings by Edward W. Orr
5. Paints, coatings, and solvents by Dieter Stoye, Werner Freitag
6. BASF handbook on basics of coating technology by Artur Goldschmidt, Hans-Joachim Streitberger.
7. European coatings handbook By Thomas Brock, Michael Groteklaes, Peter Mischke
8. UV coatings: basics, recent developments and new applications By Reinhold Schwalm

Code & Title of the Course	SCT 2506.Printing Processes and Printing Inks
Marks	50
Number of Hours per Week	2+1
Credits	3
Class	M Tech
Semester	

Sr. no.	Topics	Hrs
1	Development in the processes of printing on different metallic and non-metallic substrates.	10
2	Developments in formulation in formulation of printing inks for different applications.	10
3	Different printing processes such as offset, screen printing, digital printing, pad printing etc.	10

Text/ Source Books

- 1) Physical chemistry of Polymers, A. Tager, Mir Publishers, 197
- 2) Printing ink Formulations principles by Ronal Todd
- 3) Text book of Polymer Science by Billmeyer, John Wiley ans Sons 1984.
- 4) Application properties of Pigments by A. Karnik
- 5) Basics of Paints Technology by V.C.Malshe
- 6) Printing ink Formulations principles by Ronal Todd

Code & Title of the Course	SCT 2507.Radiation Curing Coatings*
Marks	50
Number of Hours per Week	2+1
Credits	3
Class	M Tech
Semester	

Sr. no.	Topics	Hrs
1	Theory of radiation curing. Methods of radiation curing and radiation curing techniques, selection of uv-source.	10
2	UV-curing-: fundamentals of photopolymerisation, photoinitiators types oligomers-polymers used, pigmentation	10
3	Electron-beam curing, EB-generators, Factors affecting EB-curing, application, polymers used.	10

Course Outcomes

1. Student will able to understand radiation curing system. .
2. Student will able to understand radiation sources and different formulations.
3. Student will able to understand EB sources and resin formulations.
4. Student will able to formulate paints regarding radiation curing system.

Text/ Source Books

1. Surface Coatings Science and Technology by Swaraj Paul
2. Paint and Surface Coatings by Lambourne and Strivens
3. UV coatings: basics, recent developments and new applications By Reinhold Schwalm
4. Radiation curing of coatings by J. V. Koleske
5. Radiation Curing by Patrick Gloeckner
6. Polyurethanes: coatings, adhesives and sealants by Ulrich Meier-Westhues
7. Radiation Curing in Polymer Science and Technology: Fundamentals and methods by Jean-Pierre Fouassier, J. F. Rabek
8. Radiation curing: science and technology by Socrates Peter Pappas

Code & Title of the Course	SCT 2508.Additives for Coatings
Marks	50
Number of Hours per Week	2+1
Credits	3
Class	M Tech
Semester	

Sr. no.	Topics	Hrs
1	Type of additives, additives like uv stabilizer, antioxidants, anti-ozonents,	8
2	coupling agents, rheological modifiers, anti-microbial	7
3	Chemistry of additives, evaluation of additives, mechanism of additives	7
4	newer trends in additives, functional additives.	8

Textbooks

- 1) R.Gachter and H. Muller, "Plastics Additives Hand Books", Hanser Publications, Munich (1993).
- 2) J.A. Brydson, "Plastics Materials" Buterworth – Heinmann, Oxford (1999).
- 3) J.Murphy, "The additives for Plastics Hand Book", Elsevier, Oxdford (1996).

Code & Title of the Course	SCT 2509. Polyelectrolytes & ionomers:
Marks	50
Number of Hours per Week	2+1
Credits	3
Class	M Tech
Semester	

Sr. no.	Topics	Hrs
1	Fundamentals of polyelectrolytes & ionomers	4
2	mechanism of electrolysis process, structural requirements for polymers to be polyelectrolytes & ionomers	6
3	difference with low molecular weight and conventional electrolytes, theories of polyelectrolytes, specific polymeric electrolytes based on acrylics, styrenics etc.	10
4	Various ingredients and their functions in polyelectrolytes & ionomers formulations, industrial applications.	10

Text/ Source Books

1. Ionomers: characterization, theory, and applications by Shulamith Schlick
2. Polyelectrolytes: science and technology by Masanori Hara
3. Introduction to ionomers by Adi Eisenberg, Joon-Seop Kim
4. Ionomers: synthesis, structure, properties, and applications by Martin R. Tant, K. A. Mauritz, Garth L. Wilkes
5. Basics of Paint Technology Part II, Part 2, V. C. Malshe, Prakash C. Malshe, 2008 - Coatings - 624 pages

Code & Title of the Course	SCT 2510: Nano materials*
Marks	50
Number of Hours per Week	2+1
Credits	3
Class	M Tech
Semester	

Sr. no.	Topics	Hrs
1	Importance of nano materials, natural nano materials, fullerenes, applications, (filtrations, biomedical, textiles, electrical and optical) modifications.	10
2	Different methods of characterization of nano materials. Synthesis, applications & treatments of nano silica & analogues materials	9
3	silver, ZnO, gold, nano fibers, single and MW- CNTs, iron oxide, self assembled layers, issues related to handling of nano-materials etc	11

Course Outcomes

1. Student will able to understand basic concepts like fullerenes, natural nano materials. .
2. Student will able to characterize, synthesize different nano materials like nano silica & analogues materials.
3. Student will able to formulate nano materials for filtration, biomedical, textile and electrical application.
4. Student will able to handle different nano materials like silver, iron oxide etc.

Text/ Source Books

1. Proceedings Of Prague Meetings On Macromolecules, 57th Meeting - 39th Microsymposium On Advances In Polymerization Methods - Controlled Synthesis Of Functionalized Polymers Held At Prague During 12 - 15 July 1999,
2. Thermal Analysis: Fundamentals And Applications To Polymer Science, 2nd Edition, Hatakeyama, F. X. Quinn, Wiley(Publishers), Isbn: 0-471-98362-4, May 1999
3. Atomic Force Microscopy/Scanning Tunneling Microscopy 2 (Hardcover) By Samuel H. Cohen (Editor), Marcia L. Lightbody (Editor), Plenum Us; 1 Edition (April 30, 1997).
4. Understanding Rheology By Faith A. Morrison, Oxford University Press, 2001
5. P. Mirau Solid-State Nmr Of Polymers, Chem Tec Publishing, 2001
6. Advanced macromolecular and supramolecular materials and processes, Volume 2002 by Kurt E. Geckeler
7. Conducting polymers, fundamentals and applications: a practical approach by Prasanna Chandrasekhar
8. Handbook of Radical Polymerization by Krzysztof Matyjaszewski, Thomas P. Davis
9. Advanced Engineering Chemistry by Manas Ranjan Senapati

10. Code & Title of the Course	SCT 2511: Paint Processing and its Characterization
Marks	50
Number of Hours per Week	2+1
Credits	3
Class	M Tech
Semester	

Sr. no.	Topics	Hrs
1	Paint manufacturing machinery for pigment dispersion (Ball mill, Sand mill, Attritor mills, basket mill, kaddy mills, twin shaft dispenser, alpine mills, horizontal vs. vertical mills, etc)	10
2	Manufacture of Powder Coatings, dry distempers, cement paints, oil based distempers and paints, other stiff paints, putties, etc.	9
3	Testing of paints Color thermal weather mechanical chemical etc	11

Textbooks

1. Resins for Surface Coatings, Polyurethanes Polyamides Phenolplasts Aminoplasts Maleic Resins (Waterborne & Solvent Based Surface Coatings Resins & Applications) (Volume III) Volume III Edition
2. Resins for Surface Coatings, Volume 1 2nd Edition, P.Deligny (Author), N. Tuck (Author), P. K. T. Oldring (Editor)
- 3..Resins for Surface Coatings: Acrylics and Epoxies 2nd Edition by H. Coyard (Author,)
- 4.Basics of Paint Technology Part II, Part 2, V. C. Malshe, Prakash C. Malshe, 2008 - Coatings - 624 pages

Code & Title of the Course	PHT 2101 Research Methodology
Marks	50
Number of Hours per Week	2+1
Credits	3
Class	M Tech
Semester	I

Sr.No.	Topic	Hrs.
8.	<p>Research</p> <p>Meaning of Research, Purpose of Research, Types of Research (Educational, Clinical, Experimental, Historical, Descriptive, Basic applied and Patent Oriented Research) – Objective of research- Literature survey – Use of Library, Books, & Journals – Medline – Internet, getting patents and reprints of articles as sources for literature survey. Selecting a problem and preparing research proposal for different types of research mentioned above.</p> <p>Methods and tools used in Research</p> <ul style="list-style-type: none"> • Qualitative studies, Quantitative Studies • Simple data organization, Descriptive data analysis • Limitations and sources of Error • Inquiries in form of Questionnaire, Opinionnaire or by interview • Statistical analysis of data including variance, standard deviation, students ‘t’ test and annova, correlation data and its interpretation, computer data analysis 	4
9.	<p>Documentation</p> <ul style="list-style-type: none"> • “How” of Documentation • Techniques of Documentation • Importance of Documentation • Uses of computer packages in Documentation 	4
10.	<p>The Research Report / Paper writing / thesis writing</p> <ul style="list-style-type: none"> • Different parts of the Research paper 5. Title – Title of project with author’s name 6. Abstract – Statement of the problem Background list in brief and purpose and scope 7. Key-words- 8. Methodology-Subject, Apparatus / Instrumentation, (if necessary) and procedure 	4

11.	Results – tables, Graphs, Figures, and statistical presentation Discussion – Support or non- support of hypothesis – practical & theoretical implications, conclusions Acknowledgements References Errata Importance of spell check for Entire project Use of footnotes	5
12.	Presentation (Specially for oral) <ul style="list-style-type: none"> • Importance, types, different skills • Content of presentation, format of model, Introduction and ending • Posture, Gestures, Eye contact, facial expressions stage fright • Volume- pitch, speed, pauses & language • Visual aids and seating Questionnaire	5
13.	Protection of patents and trade marks, Designs and copyrights <ul style="list-style-type: none"> • The patent system in India – Present status Intellectual property Rights (IPR), Future changes expected in Indian Patents • Advantages • The Science in Law, Turimetrics (Introduction) • What may be patented • Who may apply for patent • Preparation of patent proposal 	5
14.	Sources for procurement of Research Grants Industrial- Institution Interaction - Industrial projects – Their feasibility reports	3

Reference books:

16. Research in Education – Johan V. Best James V. Kahn
17. Presentation skills- Michael Halton- Indian Society for Institute Education
18. A Practical Introduction to copy right – Gavin Mcfarlane
19. Thesis projects in Science and Engineering – Richard M. Davis
20. Scientists in legal system – Ann labor science
21. Thesis and Assignment writing – Jonathan Anderson
22. Writing a technical paper- Donald Menzel
23. Effective Business Report writing – Leland Brown
24. Protection of Industrial property rights- Purushottam Das and Gokul Das
25. Spelling for the million – Edna furmess
26. Preparing for publication – King Edwards Hospital fund for London
27. Information technology – The Hindu speaks
28. Documentation – Genesis & Development 3792
29. Manual for evaluation of Industrial projects – United Nations
30. Manual for the preparation of Industrial feasibility studies

Code & Title of the Course	BST 2106 Intellectual Property Rights
Marks	50
Number of Hours per Week	2+1
Credits	3
Class	M Tech
Semester	I

Sr.No.	Topic	Hrs.
5.	General Introduction to IPR and Essentials of IP management <ul style="list-style-type: none"> • History of Indian and International Patent System and International Treaties • Introduction to Trademark filing in India • Introduction to Design filing in India • Introduction to Geographical Indication filing in India • Introduction to Indian Patent Law • Assessment of Invention by documentation and Search • Analysis of R&D Activity for Patentability 	10
6.	Techno-legal requirements for filing of Patent Drafting of Patent Specification	4
7.	Patent Prosecution in India Patent Prosecution at International level (Convention and PCT Routs) Agreements & Contracts for Patent Management and drafting of same Infringements for Patent Commercialisation Search and Patentability Opinion	12
8.	Case Studies: Cases of Herbal medicines, biomolecules, agrochemicals, and bulk drugs, oil and textile in India and abroad before Patent Office/ Courts	4

Reference books:

1. Intellectual Property Rights By Khushdeep Dharni, Neeraj Pandey
2. Indian Patent Law And Practice By K.C. Kankanala (Oxford India) 2013 Edition