

## Department of Dyestuff Technology

### M Tech

### DETAILED SYLLABUS

### Semester I

<b>Code &amp; Title of the Course</b>	DYT 2001 Chemistry of Functional Colorants
<b>Marks</b>	50
<b>Number of Hours per Week</b>	2 + 1
<b>Credits</b>	3
<b>Class</b>	M Tech
<b>Semester</b>	1

<b>Sr. No.</b>	<b>Topic</b>	<b>Hrs</b>
1	Introduction, Interactions of functional dyes, Optical data storage, Organic light emitting devices, Electrochromeric displays, Solar cells, Nonlinear optical dyes, Photochromic and Thermochromic colorants, liquid crystal displays.	12
2	<b>Biomedical application</b> Introduction, Photodynamic therapy, Principle of PDT, Dyes in bioanalysis and medical diagnostics, DNA sequencing, Cancer detection, activity with diazonium salts, Dyes as therapeutic agents, Anti-cancer drugs, Applications, Antiviral agents, Antifungal and antibacterial agents, Other biomedical applications	6
3	<b>Laser dyes: structure and spectroscopic properties</b> Introduction, Overview, Principles of lasers and dye lasers, Spectroscopic parameters that affect laser action, Activation and deactivation of organic molecules by light, Effects of molecular structure on fluorescence, new laser dyes from molecular engineering, New laser dyes from spectroscopic studies, Oligophenylenes, oxazoles, and benzoxazole, Coumarin laser dyes, Rhodamine laser dyes, Other commercial laser dyes.	6
4	<b>Dyes for ink jet printing</b> Introduction, Ink jet technology, Photorealistic ink jet printing, Photorealistic ink jet printers, Dyes for photorealistic ink jet printing, Aqueous ink jet dyes, Blackdyes, Magentadyes, Yellowdyes, Cyandyes, Non-aqueous ink jet dyes, Solvent inks, Hotmeltinks, Ink jet printing as a manufacturing process.	6

## References:

Author	Title
S H Kim	Functional Dyes, Elsevier BV 2006
H S Freeman and A T Peters	Colorants for non-textile Applications, Elsevier BV 2000
Klaus Hunger	Industrial Dyes-Chemistry, Properties, Applications. WILEY-VCH Verlag, 2003

<b>Code &amp; Title of the Course</b>	DYT 2101 Chemistry and Technology of Natural Dyes
<b>Marks</b>	50
<b>Number of Hours per Week</b>	2 + 1
<b>Credits</b>	3
<b>Class</b>	M Tech
<b>Semester</b>	1

Sr. No.	Topic	Hrs
1	Historical perspective of natural dyes – woad, madder, purpura, weld, Brazilwood, Cochineal, Cardinal's purple, quercitron, fustic.	6
2	Chemistry of chromophoric systems in natural colorants.	4
3	Natural food colours – carmines, betalains, monascus, paprika, annatto, lycopene, phycobilins, turmeric, chlorophylls, anthocyanins. Health aspects of natural colours.	8
4	Natural colours for textile applications.	8
5	Unit processes and operations in the manufacture of natural colorants.	4

## Books Recommended

- Natural Dyes and their Applications in Textiles by M. L. Gulrajani, IIT Delhi
- The Complete Book on Natural Dyes and Pigments by National Institute of Industrial Research Board
- Handbook on Natural Dyes for Industrial Applications by P. S. Vankar, National Institute of Industrial Research
- Natural Food Colorants by Gabriel J. Lauro and F. Jack Francis (eds), Marcel

Dekker Inc.

- e) Natural Food Colorants by G. A. F. Hendry and J. D. Houghton, Blackie and sons Ltd.

<b>Code &amp; Title of the Course</b>	DYT 2201 Chemistry and Technology of High Performance Pigments
<b>Marks</b>	50
<b>Number of Hours per Week</b>	2 + 1
<b>Credits</b>	3
<b>Class</b>	M Tech
<b>Semester</b>	1

<b>Sr. No.</b>	<b>Topic</b>	<b>Hrs</b>
1	Chemical and Physical Characteristics of performance pigments. Crystal design and crystal engineering aspects – an elementary treatment. Color and physical constitution of pigments	6
2	Monoazo pigments and disazo condensation pigments	6
3	Isoindoline, and isoindolinone pigments. Quinophthalone pigments. Dioxazine pigments.	6
4	Diketopyrrolopyrrole pigments. Perylene pigments. Quinacrodone pigments. Thiazines and oxazines	6
5	Physico-chemical principles in pigment processing. Particle morphology. Optical properties of pigmented systems. Rheological behavior of pigment dispersions. The dispersion process.	6

### References

<b>Author</b>	<b>Title and publishers</b>
H M Smith (Ed)	High Performance Pigments Wiley VCH, 2002
J M Oyarzun	Pigment Processing Curt R Vincent Verlag, Hannover 2000
W Herbst and K Hunger	Industrial Organic Pigments VCH Verlagsgesellschaft 1993
E B Faulkner and R J Schwartz (Ed)	High Performance Pigments Wiley-VCH, Weinheim 2009

## Semester II

<b>Code &amp; Title of the Course</b>	DYT 2002 Chemistry of Fluorescent Dyes
<b>Marks</b>	50
<b>Number of Hours per Week</b>	2 + 1
<b>Credits</b>	3
<b>Class</b>	M Tech
<b>Semester</b>	1

<b>Sr. No.</b>	<b>Topic</b>	<b>Hrs</b>
1	Interaction of organic molecules with electromagnetic radiation. Energy diagram. Activation and deactivation of organic molecules by light. Fluorescence and delayed fluorescence. Effect of molecular structure on fluorescence. General properties of fluorescent dyes and their requirements. Triplet-triplet absorption of organic molecules. Fluorescent quantum yields and factors affecting them.	6
2	Fluorescent aromatic hydrocarbons. Fluorescent heteroaromatic compounds.  Introduction to laser dyes. Oligophenylenes. Oxazoles and benzoxzoles. Stilbenoid compounds	6
3	Coumarins. Rhodamines. Naphthalimides. Oxzines. Carbazines. Qasi aromatic compounds: syn-bimanes, and boron compounds. Bichromophoric dyes. Phenalenones.	6
4	Fluorescent dyes in biology. Intercalating dyes. Monomeric monomethine dyes and trimethines as non-covalent nucleic acid probes  Homodimeric cyanine dyes as nucleic acid probes. Heterodimeric cyanine dyes.	6
5	Styryl dyes. Pyriliium dyes. NIR Fluorescence and the ir implications in functional applications. Squarylium dyes and pyrazine dyes	6

## References

Author	Title
S H Kim	Functional Dyes, Elsevier BV 2006
H S Freeman and A T Peters	Colorants for non-textile Applications , Elsevier BV 2000
A P Demchenko	Introduction to Fluorescence Sensing, Springer 2009

<b>Code &amp; Title of the Course</b>	DYT 2102 Mechanism of Organic Reactions
<b>Marks</b>	50
<b>Number of Hours per Week</b>	2 + 1
<b>Credits</b>	3
<b>Class</b>	M Tech
<b>Semester</b>	1

Topic	Hrs
Discussion of mechanism of organic reactions through problem solving (class work and homework) from examples chosen from advanced organic chemistry textbooks and published literature – molecular rearrangement, cyclisation leading to heterocyclic systems, oxidation, reduction, neutral high energy intermediates such as nitrenes and carbenes, concerted carbon-carbon bond forming reactions. Discussion of concepts – orbital alignment, stereochemistry, isotope effect, isotope labeling, scrambling of labels, racemisation – wherever applicable in the above examples. ~10-12 problems to be discussed per week.	30

## Books Recommended

1. Stereoelectronic Effects in Organic Chemistry by Pierre Deslongchamps, Pergamon Press
2. Organic Reaction Mechanisms – 40 Solved Cases by M. Gomez Gallego and M. A. Sierra, Springer
3. The Art of Writing Reasonable Organic Reaction Mechanisms by Robert B. Grossman, Springer
4. Fundamentals of Organic Reaction Mechanisms by J. Milton Harris and Carl C. Wamser, John Wiley and Sons

5. Stereochemistry – Conformation and Mechanism by P. S. Kalsi, New Age International (P) Limited
6. Mechanism and Theory in Organic Chemistry by Thomas H. Lowry and Kathleen S Richardson, Harper and Row
7. Fascinating Problems in Organic Reaction Mechanisms by S. Ranganathan, Holden-Day, Inc.

<b>Code &amp; Title of the Course</b>	DYT 2802 Chemistry and Technology of Agrochemicals
<b>Marks</b>	50
<b>Number of Hours per Week</b>	2 + 1
<b>Credits</b>	3
<b>Class</b>	M Tech
<b>Semester</b>	1