KIE 355/3 – Industrial Colourants

Course Objective : To know the concept of colour and various types coloured chemicals and dyes and understand their applications the manufacturing industries.

Topic	Content	Number of lecture hours	Expected outcome – upon completion of this course, the student should be able to:
1. Basic Concepts of Colour	• Electromagnetic spectrum and visible light • Colour vision and colour perception • Specification and measurement of colour • Absorption spectrum • Reflectance spectrum • Fluorescent molecules • Colour mixing	5	• Identify the colour sequence in the visible spectrum and their respective wavelengths. • Understand how colour is perceived and what factors affect the perception of colour. • Differentiate between the three dimensions of colour. • Understand the relationship between absorbed light and observed colours; complementary colours. • Understand Beer-Lambert's Law and its use. • Recognise and interpret absorption and reflectance spectra. • Understand how fluorescence occurs in certain compounds. • Understand the concept of colour mixing (additive and subtractive).
2. Colour and Constitution of Organic Molecules	• General structure of colorant molecules • Light absorption and electronic transitions • Resonance in colorant molecules • The effects of change in structure on λ_{max}	5	• Identify chromophore, auxochrome and antiauxochrome. • Explain the types of electronic transition in coloured organic molecules. • Understand the relationship between ΔE and λ_{max}. • Understand the relationship between the length of conjugated double bonds and light absorption in the visible region. • Understand the resonance concept and its importance to colorants. • Write resonance structures for organic colorants. • Understand the effects of substituent groups on λ_{max}. • Identify donor and acceptor groups. • Understand the terms bathochromic, hypsochromic, hyperchromic and hypochromic.

Topic	Content	Number of lecture hours	Expected outcome – upon completion of this course, the student should be able to:
3. Classification of Colorants	• Types of colorants • Chemical classes of dyes and pigments • Application classes of dyes • Types of textile fibres • Chemical interaction between dyes and fibres	2	• Explain the difference between dyes and pigments. • Recognise and draw the parent structure of each class of colorants. • List the ten application classes of dyes and match them with the suitable fibres. • Recognise and explain the chemical forces that are responsible for the dye – fibre interaction.
4. Azo Dyes and Pigments	• Geometrical isomerism and tautomerisation • Synthesis of azo compounds • Strategies for synthesis • Schematic representation of azo colorants	5	• Explain the phenomenon of photochromism and tautomerism in azo compounds. • Write the diazotisation and coupling mechanisms. • Recognise the structural characteristics of coupling components. • Identify coupling sites. • Write the structure of azo compounds formed from a primary amine and different coupling components. • Plan a synthetic strategy to obtain an intended azo compound. • Name an azo compound using the Winther's code or write the possible structure based on the the Winther's code.
5. Carbonyl Dyes and Pigments	• Anthraquinone • Indigoid • Fluorescent dyes • Uses	2	• Recognise the basic structure of anthraquinone and indigo colorants. • Understand the importance of H-chromophore system in indigo. • Explain the effects of substituent groups on λ_{max}. • Recognise carbonyl colorants with fluorescent properties.

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6. Phthalocyanine, polyene, Polymethine and Arylcarbonium Ion Dyes and Pigments	• Structure and properties • Uses	3	• Recognise the basic structure of phthalocyanine. • Explain the effects of substituents and crystal structure on the colour of phthalocyanine. • Recognise the characteristic structural features of polyene, polymethine and aryl carbonium ion colorants. • Explain the effects of substituent groups on λ_{max}. • Know the outstanding features of these colorants and their main use in industries.
7. Chemistry and Application of Synthetic Dyes	• Application classes of synthetic dyes (acid, direct, vat, sulphur, disperse, azoic, basic, mordant, metal-complex) • General structure • Application methods • Textile fibres • Mechanism of interaction with textile fibres	7	• Write the structure of dyes from each class. • Recognise the important structural features of each dye class. • Explain the method of application for each class. • Write the structure of several important textile fibres. • Identify the suitable fibres for a given dye class and understand the interaction mechanism between them. • Understand the good and the bad properties of each dye class.
8. Reactive Dyes (3 lectures)	• General structure • Types of reactive systems • Application methods • Bonding mechanism with fibres • Hydrolysis of reactive dyes	3	• Write the structure of several reactive systems. • Recognise the structure of reactive dyes by its reactive system. • Explain the dyeing method and the importance of base in its application. • Write the reaction mechanism between dye and fibre. • Understand the good properties of reactive dyes. • Know the problems associated with reactive dyeing.

Topic	Content	Number of lecture hours	Expected outcome – upon completion of this course, the student should be able to:
9. Pigments	• Properties of pigments • Organic pigments • Inorganic pigments • Application method	2	• Write the structure of organic and inorganic pigments. • Understand the two important requirements of a pigment. • Explain methods of obtaining pigments from dyes. • Compare the properties of organic and inorganic pigments. • Explain the method of application in industries.
10. Functional Colorants	• Dyes for LCD • Laser dyes • Dyes for solar cell • Chemichromisme	2	• Identify dyes or pigments suitable for special applications. • Understand how these colorants function. • Explain the chemichromisme term.
	TOTAL	**36**	