

FACULTY OF ENGINEERING

SYLLABUS FOR THE

T. E.

**(PRINTING ENGINEERING AND COMMUNICATION
TECHNOLOGY)**

WITH EFFECT FROM

THE YEAR 2014-2015

UNIVERSITY OF PUNE

University of Pune

**T.E. Printing Engineering 2013 – Course
(w.e.f. 2014-2015)**

SEMESTER – I											
Sr. No.	Subject Code	Subject Title	Teaching Scheme			Examination Scheme					Total Marks
			Th.	Pr.	Tut	Paper		TW	PR	OR	
						In Sem	End Sem				
1.	308281	Offset Machines	04	02	--	30	70	--	50	--	150
2.	308282	Printing Network Teletronics & Optoelectronics	03	02	--	30	70	--	--	50	150
3.	308283	Color Management & Standardization	04	02	--	30	70	25	50	--	175
4.	308284	Management Information System & Cost Estimation	04	--	--	30	70	--	--	--	100
5.	308285	Printing Professional Skill Development	--	02	--	--	--	50	--	--	50
6.	302290	Theory of Printing Machine & Machine Design	03	02	--	30	70	25	--	--	125
Total			18	10	--	500		100	150		750

SEMESTER – II											
Sr. No.	Subject Code	Subject Title	Teaching Scheme			Examination Scheme					Total Marks
			Th.	Pr.	Tut	Paper		TW	PR	OR	
						In Sem	End Sem				
1.	308286	Substrates and Coating Technology	03	--	--	30	70	--	--	--	100
2.	308287	Print Statistics	04	02	--	30	70	--	--	--	100
3.	308288	Digital Workflow and Imagesetting	04	02	--	30	70	25	50	--	175
4.	308289	Technology of Flexography	04	02	--	30	70	--	50	--	150
5.	308290	Ink Technology	03	02	--	30	70	25	50	--	175
6.	308291	Seminar and Technical Communication	--	02	--	--	--	50	--	--	50
Total			18	10	--	500		100	150		750

SEMESTER I

(308281) Offset Machines

Teaching Scheme

Theory: 4 Hours/Week

Practical: 2 hours/ Week

Examination Scheme

Paper-In Sem:30marks

End Sem: 70 marks

Practical: 50 marks

Prerequisites: Basic Printing Techniques, Material Science, Basic Elements of Mechanical Engineering, Electrical Machines and Utilization

Unit 1: Basics of Offset Workflow and CTP technologies

[8 hours]

Sheet fed Process Flow diagram, construction of printing units, Offset Printing used for commercial and packaging, automatic plate changing, Surface preparation for Offset, lay outing preparation, CTP –thermal and violet, CTCP and other technologies, Role of Silver halide layer, Digital Plate Surface preparation, thermal plate and Violet plate processing

Unit 2: Inking Systems and Dampening Systems used in Sheet fed and Web Offset Process

[8 hours]

Study of different inking systems, different metering systems of ink duct, roller diameters roller materials for conventional and hybrid UV machines, ceramic and duct roller, temperature ranges maintained on machine, heatset and coldest inks, UV, EB inks. Construction of Dampening System, Developments and modifications in dampening system construction, Dampening Roller materials, fountain solutions & their characteristics, metering of dampening solution. Role of different constituents used in fountain solutions.

Unit 3: Sheet / Web Travel through the machine and sheet / Web drying methods

[6 hours]

Feeders – study of all parts of feeders, mechanisms sheet transfer, shaft less feeders, Web tension control, load cells, web handling, factors affecting tension- press related tension and paper related tension, modulus of elasticity of paper, Registration control- autoregistration control Auxiliary equipments used on web offset- remoisturisers unit, anti-static devices, temperature controlled oscillators, Total blowers, grippers, mechanism in delivery system, IR dryers and UV dryers

Unit 4: Process Control in Offset Process and Evaluation of Print Quality [8 hours]

Inspection and basic checks of paper, ink, fountain and washes required for production as well as use of color control strip for achieving aimed solid ink densities, tone value increase, trapping and conformance to various standards such as GRACoL, SWOP, FOGRA and ISO. Study of various test chart elements. Use of color characterisation data charts. Understanding various test elements to understand behaviour of inking, dampening, printing pressures, Test elements such as grey balance, color gamut, tone value increase, register. Understanding ISO 12647-3 for cold set newspaper, Measurement of basic quality checks for paper, inks and other consumables.

Unit 5: Drives and electronic controls used in Sheetfed/ Web Offset Presses [6 hours]

Motion control systems for registration, main drives, ink keys, duct roller settings. Different electronic controls used for feeders, printing units, inking, dampening, delivery units.

Unit 6: Make ready Operations, Troubleshooting and Requirements of Green Initiatives in printing [8 hours]

Types of Make ready operations, fastermakeready using automatic ink key presetting, inline register control. Environmental problems due to waste generated from press room, storage & disposal of ink, Disposal of founts and washes, Deinking procedures, Sheet and Web Offset troubleshooting, press troubles, paper and ink problems, infeed troubles-splicebreaks, web breaks, Printing unit problems- gear streaks, uneven impression, slurring, doubling, inking related problems, dampening related problems, print quality related problems. Use of recycled papers, using certified resources such as Forest Stewardship council (FSC) or Sustainable Forestry Initiative (SFI), Deinking.

Term work:

Term Work shall consist of following TEN experiments:

- 1) To mount plate on plate cylinder and prepare standard operating procedure for the same
- 2) To mount blanket on blanket cylinder and prepare standard operating procedure for the same.
- 3) Setting of ink duct and tracing ink path on the inking unit and checking adjustment by printing simple test forme

- 4) Setting of dampening system and testing using simple test forme
- 5) To set and operate feeder (stream feeder)
- 6) To print single colour job and study registration
- 7) Simple evaluation and quality checks for ink, fountain solution, paper, washes.
- 8) Evaluation of test chart for analyzing print quality
- 9) Conventional platemaking, planning layout, plate exposing, development
- 10) Understanding image quality metrics using MATLAB software

Assignments:

- 1) Study of standard test images as given in ISO 12640-1 and ISO 12640-2 and BVDM Roman 16
- 2) Survey of image quality metrics

Reference books:

- 1) GATF, The lithographic manual. GATF
- 2) Lathrop, Kunst, Photo offset, GATF
- 3) GATF, Quality & Productivity in the Graphic arts, GATF
- 4) Ernest Hutching , A surveys of printing process, A. D. Hutchings
- 5) Durrant, Printing m/c, Focal press, London.
- 6) Ian Faux, Litho Printing
- 7) Bulinski, Solving sheet-fed offset press problems, GATF
- 8) Ian Faux, Modern Lithography- McDonald & Evans Ltd.
- 9) Porter, A.S., Manual for lithographic press operation, Litho training services Ltd. London
- 10) Misra C. S., Technology of offset printing, Anupam Prakashan, Delhi.
- 11) Krisnamurthy, V. S. Basics of Modern printing processes, maxseltype, Madras.
- 12) Handbook of Print Media
- 13)GATF's Sheet-fed Offset Press Operating
- 14) The Thames and Hudson Manual of Advanced Lithography
- 15) Hugh Speirs, Introduction to Offset Lithographic Printing

(308282) Printing Network Teletronics and Optoelectronics

Teaching Scheme

Theory: 3 Hours/Week

Practical: 2 Hours/ Week

Examination Scheme

Paper - In Sem: 30 marks

End Sem: 70 marks

Oral: 25 marks

Prerequisites: Printing Digital Electronics, Microprocessor and Microcontroller Techniques in Printing

Unit 1: Printing Information, Digitization and Transmission [12 Hours]

Necessity of Printing Information, transmission at long distance. Necessity of Modulation and different types of modulation (Block diagram and conceptual treatment only). Pulse modulation and their types (theoretical treatment and simple mathematical approach only), sampling theorem, quantization, Binary coding, companding and their types, multiplexing techniques. Data Encryption and Decryption techniques, security issues in Printing. Data transfer techniques, Data channels and transmission, various data networks. Use of communication in the field of printing.

Unit 2: Optical Fibers and Fiber Optic Communication [12 Hours]

Types, working principles and characteristics of optical Fiber, Fiber configuration and performance comparison, Fiber connector types and their features. Losses in fibers (to be covered in detail). Basic fiber optic communication system (block diagram treatment only). Applications of optical communications such as paper and currency Note counting security applications, paper thickness measurement and control. (only block diagram treatment with simple mathematical applicable if any) Fiber optic communication set up used in paper industry. (complete end to end set up - block diagram and concept).

Unit 3: Modern Technologies and applications [8 Hours]

Infrared LED application in Plate making. Fundamentals of wireless communication. (Frequency ranges, applications and block diagram only). Wi-fi technology (Block diagram, concept and frequency ranges only) and applications in Printing. RFID i.e. Radio Frequency Identification and its applications in Printing. RFID smart ticket application. Use of RFID in inventory management.

Unit 4: Operating Systems [12 Hours]

Introduction, What is operating system, types of OS, Functions and features of OS, structure of windows, Unix / Linux, MAC, network OS (NT, Novel), design issues of OS. OS specially designed for printing applications

Unit 5: Networking

[8 Hours]

What is networking, advantages & disadvantages of networking, topologies, types of network, layered structure, design issues of layered structure, ISO / OSI model, TCP / IP model, intranet & internet, network protocols - ICMP, POP3, SMTP, FTP, TFTP, IMAP.

Unit 6: Internetworking

[4 Hours]

Leased lines, ISDN, VSAT, and VPN, Internetworking devices such as modems, repeaters, hubs, switches, routers, gateways, bridges, and routers. Applications: study of networking application such as video conferencing, VoIP, VoN

Term work:

Term Work shall consist of following Twelve experiments:

- 1) Verification of sampling theorem. And PAM techniques: Ideal, Natural, flat samples.
- 2) Study of various pulse modulation techniques PWM, PPM.
- 3) Study of compounded PCM using a law and u law and differential PCM.
- 4) Measure the numerical aperture of a fiber with and without visible light source.
- 5) To measure attenuation of optical fiber (length of fiber should be at least 10 meters)
- 6) Test simple fiber optic link for transmission for a)Analog signal and b) Digital signal.
- 7) Study of Linux and MAC
- 8) Study of LAN.
- 9) Study of Modem.
- 10) Study of networking components
- 11) To simulate file transfer protocol.
- 12) Study of TCP/IP or VOIP

Reference Books :

- 1) A. B. Carlson ``communication system'' MacGraw Hill Publication.
- 2) Taub and schilling ``Principles of communication system'' Tata MacGraw Hill Publication.
- 3) Optical Fiber communication - G. Keiser MacGraw Hill Publication.

- 4) Optical Fiber communication principles & practice - J senior - Prentice Hall publication.
- 5) Telecommunication switching systems and networks -T. Vishwanathan Prentice Hall Publication.
- 6) Computer Network by Tanenbaum (P41)
- 7) MS-DOS by Ray Duncan (BPB Publications)
- 8) Data Communication and distributed network by Black (P41)
- 9) IBM PC and clones by Govindarajalu (Tata McGraw Hill)

(308283) Colour Management & Standardization

Teaching Scheme

Theory: 4 Hours/Week
marks
Practical: 2 Hours/ Week

Examination Scheme

Paper: In Sem: 30
End Sem: 70 marks
Term Work: 25 marks
Practical: 50 marks

Prerequisites: Basic Printing Techniques, Preproduction Techniques

Unit 1: Understanding Colour physics [6 hours]

Colour Science, Electromagnetic spectrum, Psychological point of view, Color Theory, Additive colour synthesis, substrates colour synthesis, Reflectance properties of process ink Colour Perception, Human vision mechanism – Trichromancy, Opponency; Illuminant : Source & Illuminant, Colour Temperature, Spectral Power Distribution, Viewing condition, Object properties: Transmission, Absorption, scattering

Unit 2: Colour Systems [8 hours]

Colour systems & colour spaces, Basic perceptual attributes of colour, Colour Systems based on colour mixing, Colour Systems based on uniform Colour perception – the munsell colour system, the natural colour system, OSA uniform colour scale system, Colour Systems based on Colour matching – The CIE colour systems, Concept of standard observer, Standard Illuminant, color matching experiment, CIE, xyY, Luv, Hunter Lab, CIELAB, CIE CAM02

Unit 3: Color Measurement [8 hours]

Colour measurement, Basic principles of colour measurement systems, Colour Charts, Colour Reference Catalogue, Colour Measuring Instruments: Densitometer, colorimeter, Spectrophotometer; Visual Colour Assessment, Instrumental Colour Assessment, Colour Tolerance, Colour Difference, Colour processing software MATLAB, Color gamut calculations and mapping

Unit 4: Colorants [8 hours]

Dyes versus Pigment, Classification of colorants, Metamerism : Cause of metamerism, Metamerism Index, Spectral match, Metameric match, Types of metamerism, Color inconstancy; Understanding KubelkaMunk Theory, Role and Application of KM theory for

color matching, Producing colors: Colour mixing laws, Visual based color matching, Instrumental based color matching.

Unit 5: Color Management

[8 hours]

Need for colour management system , Concept of colour management, Colour system, Device dependant (conventional) workflow, device independent (modern) workflow, International colour consortium (ICC), Four c's of colour management, Color Management Tools: Test charts for different devices, Production of different colour profiles, Rendering intent: Perceptual rendering intent, Relative & Absolute colorimetric intent, Saturation intent, Colourful, Chroma Plus, Gamut mapping, Logo Classic

Unit 6: Press Standardisation

[6 hours]

Press standardization, need for standardization, Press optimization, variables in printing process such as gravure, flexo, offset, digital, types of test forms for standardization, Proof to Press colour management, Printer calibration, Printer linearization, Proofer calibration.

Term Work

Term Work shall consist of following TEN experiments:

- 1) Study the effect of substrate on Trapping and Gray balance.
- 2) Calculate CIE tristimulus values X, Y, Z for given patches.
- 3) Study the effect of different Illuminants on CIE colour Co-ordinates.
- 4) Perform the visual color assessment for measuring color difference
- 5) Perform the Instrumental color assessment for calculating color difference
- 6) Calibrate the monitor and create a monitor profile.
- 7) Generate and Measure a Printer test chart and develop an ICC printer profile.
- 8) Measure a scanner test chart and create a scanner profile.
- 9) Perform Proofer calibration for a given media.
- 10) Develop a Soft proof and Hard proof.
- 11) Study the colour processing software : Mat Lab
- 12) Applications of Mat-Lab software for colour processing.

Reference Books:

- 1) Phil Green, Understanding Digital Color, GATF press

- 2) Gray G. Field, Color & its reproduction, GATF press
- 3) Fred W. Billmeyer, Jr. Max Saltzman, Principles of Color Technology, John Wiley & sons, A Wiley interscience publication
- 4) Abhay Sharma ,Understanding Color Management
- 5) Richard M. Adams, Joshua B. Weisberg GATF press, The GATF practical guide toColor Management
- 6) R.W.G Hunt, The Reproduction of Color, Fountain Press, England
- 7) E.P. Danger, The Color Handbook, Gower Publication

(308284) Management Information System & Cost Estimation

Teaching Scheme

Theory: 4 Hours/Week

Examination Scheme

Paper: In Sem: 30 marks

End Sem: 70 marks

UNIT 1: Basics of Management

[8 hours]

Concept of Management, Functions of Management, MBO, Organization, Types of organizations, Functional departments of organization, Competitive Environment, Elements of competitive environment

UNIT 2: Basics of MIS

[8 hours]

Need, Purpose and objectives, Contemporary approach to MIS, Information as a strategic resource, Use of information for competitive advantage, MIS as an instrument for the organizational change, basics of CIP3 and CIP4

UNIT 3: Requirements & Workflow of MIS

[8 hours]

Data base management system, Data warehousing and data mining, systems analysis and design, Systems Development Life Cycle, Information security and control, Decision support system, Group decision support system, Executive information system, Executive support system, Expert systems and Knowledge based expert systems, requirements & workflow of CIP3 and CIP4

UNIT 4: Enterprise Management Systems

[8 hours]

Enterprise Management System, Enterprise Resource Planning, ERP Model and Modules, Benefits of ERP, ERP Implementation, ERP Product Evaluation, Supply Chain Management, Information management in SCM, Customer relationship management, EMS and MIS

UNIT 5: MIS in a Digital Firm

[8 hours]

Introduction to E-Business Enterprise: A digital firm, Organization of business in digital firm, Real time enterprise, Applications of MIS to E Business like Personnel, Financial, Production, Raw material, Marketing management, MIS applications in service industry

UNIT 6: Costing & Estimation**[8 hours]**

Elements of cost, product cost and process cost, Marginal cost, standard cost, Direct Material, Direct labor, Factory cost, Administration, Definition of Estimation, Elements of estimation, Standard costing as a tool for estimation, Estimation of substrate, ink and other raw materials used for the print production

References

- 1) Waman S. Jawadekar, Management Information Systems, Text and Cases, 4thEdition, Tata McGraw Hill
- 2) Davis and Olson, Management Information Systems, Tata McGraw Hill
- 3) Sadagopan, Management Information Systems, Prentice Hall
- 4) Turban and Aronson, Decision Support Systems and Intelligent Systems, Pearson Education Asia
- 5) Rajaraman, Analysis and Design of Information System, Prentice Hall
- 6) Pradeep Gupta; Principles of Management
- 7) B. K. Chatterjee; Cost and Management Accounting
- 8) B. K. Bhar; Cost Accounting

(308285) Print Professional Skill Development

Teaching Scheme

Practical: 2 Hours/ Week

Examination Scheme

Term work: 50 Marks

Prerequisites: Basic Printing Techniques, Print Layout and Design

Students shall learn and acquire professional skills to prepare visiting card and greeting cards. The entire job shall be carried out using industry practices.

Term work:

Term Work shall consist of following TEN experiments:

- 1) To discuss workflow of different printing processes such as screen printing, digital printing. To draw flow-chart for workflow and understand the peculiarities of each process for production
- 2) To design greeting card and envelope(in Adobe In-Design) for screen printing process
- 3) To apply the output parameters and process the designed job for screen printing purpose.
- 4) To design a visiting card for printing by digital printing process
- 5) To apply the output parameters and process the designed job for digital printing process
- 6) To decide the print production parameters for the printing of Greeting card and understand and arrange required materials for the job.
- 7) To prepare the screen for the Greeting card and envelope printing
- 8) To print greeting card in one color/two color. And to print envelop. To give any post printing operations if required or any special effects like velvet raised etc.
- 9) Understand print operations carried out on digital printing machine
- 10) To print Visiting card by varying print parameters such as resolution and other variables

(302290)Theory and Design of Printing Machines

Teaching Scheme

Theory: 3 Hours/Week

Practical: 2 Hours/ Week

Examination Scheme

Paper: In Sem: 30 marks

End Sem: 70 marks

Term Work: 25 marks

Prerequisites: Strength of Machine Elements, Theory of Printing Machines

Unit- I: Design Process:

[6 hours]

Machine Design, Traditional design methods, Basic procedure of Machine Design, Forming Design specifications, Requisites of design engineer, Design of machine elements, Sources of Design data, Use of Design data book, Use of standards in design, Selection of preferred sizes. **Design of Simple Machine parts:**Factor of safety, Service factor, Design of simple machine parts - Cotter joint, Knuckle jointand Levers, Eccentric loading.

Unit II: Shafts, keys and couplings

[8 hours]

Transmission shaft, A.S.M.E. code for shaft design, Shaft design on torsional rigidity basis. Design of keys – square, saddle and sunk keys. Design of couplings – Flange coupling, Bush pin type flexible couplings. Basic types of screw fastenings, cap screws, set screws, locking devices, I.S.O. Metric screw threads.

Unit III:Springs:

[8 hours]

Types, Material and applications of springs, spring stiffness, Wahl's factor, Spring index. Helical compression and tension spring – strength and deflection equation, end types. Helical torsion spring – strength and deflection equation, end types.

Rolling Contact Bearing: Types of rolling contact Bearings, Selection of rolling contact bearings from manufacturer's catalogue (Single row deep groove), Mounting of Bearings,Lubrication of Bearings, Types of failure of rolling contact bearings, causes and remedies.

Unit IV:Gears:

[8 hours]

Classification of gears. Spur gears- Terminology in gears, law of gearing, conjugate action, involute &cycloidal profile, path of contact, interference, undercutting, methods to avoid interference & undercutting, rack shift , effect of centre distance variation .

Helical gears – Normal & transverse module. [Theoretical treatment only][8 hours]

Unit V: Gear trains: [6 hours]

Worm & worm gears. Bevel gears- Terminology, geometrical relationship, applications.

Internal gears. [Theoretical treatment only]

Types of gear trains – compound, epicyclic, compound reverted, velocity ratio by tabular method for epicyclic gear train, holding torque. [8 hours]

Unit VI: Cam & followers [6 hours]

Types of cams & followers, types of follower motions. Determination of cam profiles for given follower motion, cams with specified contours. [8 hours]

Term Work

(Record of the following drawings and assignments)

List of Drawings

- 1) Component drawing and assembly drawing of complete drive for printing machine after measuring on printing machine. Fits, tolerances and part list to be shown on drawing sheet. (Two full imperial size drawing sheets)
- 2) Design and drawing of two sub assemblies of the following – Cotter Joint, Knuckle Joint, Flange Coupling, Lever
- 3) Construction of various cam profiles.
- 4) Construction of gear tooth profiles.

Assignment

A journal consisting of report on above subassemblies and at least three assignments based on theory.

Reference books

1. Shigley J.E., Mechanical Engg. Design, McGraw Hill Publication.
2. Spotts M.F., Design of Mechanical Elements, Prentice Hall International
3. Bhandari V.B., Design of Machine elements, Tata McGraw Hill Publication.
4. Design data – P.S.G. College of Technology, Coimbatore.
- 5) Thomas Bevan – Theory of Machine, CBS Publishers and Distributors, Delhi.
- 6) Joseph E. Shigley – Theory of Machine and Mechanisms, McGraw Hill International

Book Company.

SEMESTER II

(308286) Substrates and Coatings Technology

Teaching Scheme

Theory: 3 Hours/Week

Examination Scheme

Paper: In Sem: 30 marks

End Sem: 70 marks

Pre-requisites: Basic Printing Techniques, Material Science

Unit 1: Manufacturing of Substrates

[6 hours]

Manufacturing of polymeric substrates, Extrusion, Co-extrusion, manufacturing defects such as gels, black specks, Causes and Remedies of Manufacturing Defects, Manufacturing of porous substrates, calendering process, Inspection systems for substrate manufacturing

Unit 2: Non-absorbent Substrate

[6 hours]

Variety of Non-absorbent substrates, Polymer substrate and their properties, Role of plasticizers in polymers, Role of impact modifiers and other additives in polymers, Degradation of polymers, Mechanical behaviour of polymers, need of surface treatment, methods of surface treatment, corona treatment, flame treatment, plasma treatment, effect of treatments on Polymer substrates,

Unit 3: Substrate and Ink Interaction

[6 hours]

Substrate's surface energy and its components, methods to approximate surface energy: dyne pens, sessile drop method, geometric mean equation, acid-base theory; interfacial tension, ink's surface tension, ink spreading on substrate: spreading co-efficient, ink-substrate bonding: work of adhesion, mechanism of ink transfer, nature and extent of ink spreading after transfer, substrate and ink film distortion under pressure, drying and setting of ink on substrate, effect of ink vehicle penetration on coating structure.

Unit 4: Substrate Characteristics and Print Quality

[6 hours]

Topography, micro and macro roughness, smoothness and porosity, compressibility, absorptivity, surface energy, substrate behaviour in nip, effect of substrate properties on ink transfer and print quality.

Unit 5: Absorbent Substrates**[6 hours]**

Variety of absorbent substrates, Manufacturing of Paper, Calendering process, Significance of Paper properties on Print Quality, Surface and Internal sizing, Sizing considerations, Measurement of sizing, Sizing Agents used- rosin, AKD, ASA, Trouble shooting of sizing problems, Effect of Plasma modification on surface properties and printability of coated papers

Unit 6: Coatings Techniques**[6 hours]**

Fundamentals of coating for Paper and Board, Coating components, Coating processes and Equipments, Coating formulation, Coating rheology, Drying process, Types of Drying, Coat Weight calculation, Evaluation of coated paper, Performance evaluation of paper in printing, Effect of Coating Pigment on Color and Light fastness

Reference Books:

1. A. S. Athalye, (2002), Plastic Processing Handbook, Multi-tech Publishing
2. Aaron L. Brody, Kenneth S. Marsh, (1997), Encyclopedia of Packaging Technology, 2nd Edition A Wiley-Interscience Publication.
3. Abdel-Bery, E. M. (2003). *Handbook of Plastic Films*. Rapra Technology Limited, Shawbury, Shrewsbury, Shropshire SY4 4NR, UK
4. Cantor, K., 2006. *Blown film extrusion-An introduction*. 1st ed., Munich-Hanser.
5. Murphy, J., 2003. *Additives for Plastics Handbook*, 2nd edition, UK-Elsevier Advanced Technology.
6. Kruss (07/2007). Practical Contact angle Measurements.
7. Camtel Ltd. (2002). Standard Test Method for Interfacial Tension of Oil against Water by the Ring Method – ASTM: D 971 – 99a.
8. Gravure Association of America. (2003). *Gravure Process and Technology*. Gravure Education Foundation and Gravure Association of America, Rochester, NY, USA
9. Gullichsen J. and Paulapuro H., “Papermaking Science and Technology, Book 4: Papermaking Chemistry (Ed. Neimo L.)”, Finnish Paper Engineers’ Association and TAPPI
10. Roberts J.C. “Paper Chemistry” 2nd Ed., Blackie Academic & Professional.

11. Casey J.P., "Pulp and Paper Chemistry and Chemical Technology", 3rd Ed., Vol 3,
John Wiley & Sons.
12. Smook G. A. "Handbook for Pulp and Paper Technologists", 7th Ed., TAPPI Press.

(308287) Print Statistics

Teaching Scheme

Theory : 4 Hours/Week

Practicals: 2 Hours/ Week

Examination Scheme

Paper: In Sem: 30 marks

End Sem: 70 marks

Prerequisites: Engineering Mathematics 3

Unit 1: Quality, Process, Control and Process Variability [8 hours]

Basic concepts, TQM, Processes and SPC System, Basic tools, Information about process, Process mapping and flowcharting, process analysis, Variation, types and causes of variation

Unit 2: Data collection and data distribution [8 hours]

Approach, Sampling, sampling distribution and unbiasedness, determining the sample size, collection of data, bar charts, Normal distribution, Binomial and multinomial distribution, Poisson distribution, Geometric distribution, Exponential distribution, Uniform distribution, areas under normal curve

Unit 3: Exploratory data analysis [8 hours]

Histogram , Scatter diagram, amount of variability of data set, Box and whisker plot, Empirical quantiles, quartiles and the IQR, The central limit theorem, standardizing averages, application of central limit theorem, Measures of accuracy or centering, The centre of a data set, the amount of variability of a data set, Measures or precision or spread

Unit 4: Process analysis, control and Improvement [8 hours]

Run charts, Control charts for variables such as \bar{X} -R chart, \bar{X} -S chart, X-MR, Zone chart; Process problem solving, Pareto analysis, cause and effect analysis, use of control charts for managing out of control processes,

Unit 5: Basic Statistical Models [8 hours]

Random samples and statistical models, distribution features and sample statistics, estimating true distribution, simple linear regression and correlation model, correlation coefficient, Introduction to multiple linear regression

Unit 6: Six Sigma process quality**[8 hours]**

Process Capability Analysis, SPC and management system, Defining six sigma, benefits, and problem solving process (DMAIC), six sigma and role of design of experiments, Break through management

Term Work:

Term work shall consist of following TEN experiments or assignments presented in the form of journal.

1. Analysis of spectral data by histogram
2. Pareto Analysis
3. Analysis of Print Density by X bar- R chart
4. Analysis of Print Density by X bar- S chart
5. Analysis of Colour Difference by X-MR chart
6. Evaluation of printing variables by zone chart
7. Analysis of different print variables by interactive plot
8. Capability analysis of a print process
9. Analysis of data using box plot
10. Root cause analysis using cause and effect diagram for the given problem
11. Process mapping / Process flowcharting for the given process

References:

- 1) John S. Oakland, (2003), Statistical Process Control, 5th Edition, Butterworth-Heinemann
- 2) Thomas Pyzdek, (2003), The Six Sigma Handbook: A complete guide for Green Belts, Black Belts and Managers at all levels, McGraw-Hill Companies, Inc.
- 3) Modi S. M., Statistical Process Control and Related Quality Tools, D. L. Shah Trust
- 4) Smith G. M., Statistical Process Control and Quality Improvement, 5th Edition.
- 5) Walpole R., Myers R. H., Myers S. L., Ye K., Probability and Statistics for Engineers and Scientists, 8th Edition, Pearson Education
- 6) Dekking F.M., Kraaikamp C., Lopuhaa H.P., Meester L.E., A Modern Introduction to Probability and Statistics, Springer

(308288) Digital Workflow & Image Setting

Teaching Scheme

Theory: 4 Hours/Week

Practical: 2 Hours/Week

Examination Scheme

Paper: In Sem: 30 marks

End Sem: 70 marks

Practical: 50 Marks

Term Work: 25 marks

Prerequisites: PreProduction Techniques

Unit 1: Pre-media to pre-press [8 hours]

PS, PDF, Raster Image Processor, Image setter types, CTP types, output resolution, Screening – rational & irrational, Font Emulation v/s Replacement, Tagged PDF, JDF, and PJTF

Unit 2: Introduction, Elements and Functions of Workflow [8 hours]

Introduction to workflow, Job flow & workflow, digital workflow & its significance, comparison between conventional & digital workflow. Elements of workflow, job ticket, pre-flight checking, trapping, proofing, imposition, archiving, corrections, conversion, image replacement, APR, OPI servers, networking.

Unit 3: Types of workflow modules [8 hours]

Management module, production module, job administration module, job archiving module, imposition workflow, JDF, PDF workflow

Unit 4: Digital Image Processing [6 hours]

Fundamentals, Digital Image Processing, Image Compression techniques and their application, Anti aliasing and interpolation

Unit 5: Proofing [6 hours]

Digital Proofing, Soft proof, hard proof, proofing technologies viz: inkjet, electro photography, thermography

Unit 6: Integration of pre-press, press and post-press [6 hours]

Integrated print solutions through proper integration of pre-press, press and post-press, latest developments in pre-press and customer communication and job submission

Term Work:

Note: Term Work shall consist of following TEN experiments:

- 1) Covert file into various file formats and check its compatibility
- 2) Conversion to PS & output, conversion to XPS and output
- 3) Conversion to PDF & output
- 4) Scanning a document thru OCR and take output
- 5) Comparison of different resolutions & different file formats
- 6) To prepare file for service bureau
- 7) Study of RIP software
- 8) Study of Proofing software
- 9) Output through digital proofer
- 10) Study of workflow software

Reference Books:

- 1) H Kipphan, handbook of Print Media, Springer – VetagBzlin Heidelberg, 2001
- 2) Richard M. Adams II & Frank d – Romano, Computer to Plate Automating the Printing Industry, GATF Press, 2nd edition.
- 3) Michel L. Kleper, The Hand Book of Digital Publishing (Volume I) PH, PTR Publishing
- 4) N.NSarkar, Art and Print Production, Oxford Publication

(308289)Technology of Flexography

Teaching Scheme

Theory: 4 Hrs/ Week

Practical: 2 Hrs/ Week

Examination Scheme

Paper: In Sem: 30 marks

End Sem: 70 Marks

Practical: 50 Marks

Prerequisites: Basic Printing Techniques, Material Science

Unit 1

[6 hours]

Surface Preparation for Flexo: Flexo artwork, Design considerations, Types of Flexo Plates, Processing of Rubber and Photopolymer plates, Comparison between Rubber and Photopolymer Plates, Types of photopolymer platemaking, Processing machines : Compact and Inline flexo plate wash outs Safety regulations. Solvent recovery units and its safety regulations.

Unit 2

[6 hours]

Requirements of Photopolymer Plates: Layout considerations, Specifications of negative, Distortion, Storage and Handling of raw and used plates, Mounting and De-mounting of plates

Unit 3

[7 hours]

Conventional Flexo Plates: Purpose and Effects of Back-exposure, Main exposure, Wash-out, Drying, Post-exposure and Finishing, Types of Wash-out Solvents, Standardization of Conventional Flexo Plate, Environmental concerns.

Unit 4

[6 hours]

Digital Flexo Plates: Characteristics of Digital Flexo Plates, Digital Workflow, Types of images, Imaging of CTP, Ablation technique, Digital Engraving, Types of lasers used. Digital Imaging technologies for flexo. Impact of digital flexo plate making on evolution of flexo printing. Dot structure and techniques of achieving Flat top dot on flexo plates. Elastomers used in direct engraving. Comparison of Direct engraving and digital photopolymer

Unit 5**[8 hours]**

Flexography Process: Introduction, Types of Flexo Press, Press Configurations, Types of dryers, Efficiency of dryer, Sections of a Flexo Press, Flexo Products and application. Categorizing Flexo presses into high end and low end commercials In High end: Narrow Web and Wide Web New advancements in auto registration technologies Impact of servo motors in improving flexo printing techniques. Flexo plate mounters and post printing cleaners Post press attachments on flexo machines.

Unit 6**[7 hours]**

Ink Metering for Flexography: Fountain and Anilox Roller for Flexography, Purpose of Fountain and Anilox Roller, Fountain roller bases and specifications, Role of anilox in Flexo, Factors affecting anilox selection, Anilox roller construction, Anilox coverings-Chrome and Ceramic, Cell configurations, Anilox cleaning, Storage and Maintenance.

Term Work:

Note: Term-work shall consist following TEN experiments.

1. Introduction to Flexo Plate processing Machine.
2. Performing Wash-out Test on 2.84 mm photopolymer plate.
3. Performing Back-Exposure Test on 2.84 mm photopolymer plate.
4. Performing Main-Exposure Test on 2.84 mm photopolymer plate.
5. Performing Post –Exposure and Light Finishing Test on 2.84 mm photopolymer plate.
6. Preparation of PP plate with a 4-mil negative.
7. Preparation of PP plate with a 7-mil negative.
8. Study of Flexo machine principles.
9. To print single color with Conventional PP Plate by a Flexo process on PE substrate.
10. To print single color with Conventional PP Plate by a Flexo process on PE substrate.

Tutorials/Assignments:

1. Analysis of Flexo photopolymer plates
2. Analysis of Flexo prints.

Reference Books:

1. D. C. Mulvihill, (1985), Flexo Primer, Foundation of FTA.
2. The Flexography Beginner, Volume VI, FTA
3. Flexography Principles and Practices, 4th edition, Foundation of FTA
4. Flexography Principles and Practices, 5th edition, Foundation of FTA
5. Tony White, (1998), High Quality Flexography, Pira International.
6. W. R. Durrant, (1989), Printing-A Guide to Systems and their Uses, Heinemann Professional Publishing.
7. P. Laden, Chemistry and Technology of Water based Inks, Blackie.
8. H. Kipphan, (2001), Handbook of Print Media, ISBN: 3-540-67326-1 Springer-Verlag Berlin Heidelberg.
9. W. R. Durrant, Machine Printing, Heinemann Professional Publishing.

(308290) Ink Technology

Teaching Scheme

Theory: 3 Hours/Week

Practical: 2 Hours/ Week

Examination Scheme

Paper -In Sem: 30 marks

End Sem: 70 Marks

Practical: 50 marks

Term Work: 25 marks

Prerequisites: Engineering Sciences I and II, Material Science

Unit 1: Introduction to Printing Inks and Ink ingredients

[8 hours]

Difference between Paints and Inks; Concept of Dyes & Pigments; Elements of inks: Types of pigments: Chemistry and technology of Organic pigment, Inorganic pigment and Extenders, Pigment properties; Additives: Wetting and dispersing agents, Viscosity controller, Dryers, Flow and levelling agents, Anti-foam, Adhesion promoter, UV-Stabilizers, Plasticisers, Waxes, Surfactants, Antioxidants and other additives; Solvents: solvents used for ink manufacturing, classification of Solvents, their characteristics, uses and application; Resins : Chemistry and Technology of Natural resins, Synthetic resins and their application.

Unit 2: Different types of Printing Inks

[7 hours]

Classification of Inks on the basis of Printing Processes- Lithography, Letterpress, Gravure, Flexographic, Screen, inkjet, Photostat copier, their merits and demerits. Specialty Inks: Metallic inks; security and special effect printing inks, Thermographic, Scented, Fluorescent, Decorative Product Inks. Ink for Metal containers, coatings and linings. Role of inks for emerging technologies like RFID, Solar cells. Professional approach to develop ink for food products, general consumables, cosmetics, pharmaceuticals, engineering materials and other utilities

Unit 3: Rheology of Printing Inks

[8 hours]

Basic understanding of Rheology, Shear Flow, Shear Rate, Shear Stress, Newtonian fluids, non-Newtonian fluids , Shear Thinning Liquids, Shear Thickening Liquids, Thixotropy of

Ink, Visco-Elasticity, Behaviour of Inks on machines; Storage stability of Inks, Factors that have effect on Rheological Behaviour of Printing Ink, Influence of Ink Rheology on Printing Quality. Study of Viscometer and rheometer.

Unit 4: Setting and Drying of Printing Inks

[6 hours]

Setting of printing ink; Methods of Ink Drying: Radiation curable systems, Infra-red Curing, Ultra-Violet Curing, Micro-Wave and Radio-Frequency Drying, Electron-Beam Curing Radiation Curable Equipments, Future trends.

Unit 5: Formulation and Manufacturing of printing inks

[7 hours]

Formulation of Inks based on Printing Process and for various substrates. Factors to be considered while formulating printing inks. Base ink system, Extenders, Heavy ink systems, Standard ink system. Manufacturing techniques for various printing process inks. Preparation of varnishes, Ink Pigment Dispersion Process: Wetting of the Pigment Particles, Breakdown of the Pigment Particles, Stabilization of the Dispersion; The influence of various process parameters on the pigment dispersion. Mixing and milling equipments: Three roll mill, Bead mill, Attritor mill, Grinding Media, Handling, transportation and storage of ink.

Unit 6: Testing and Quality control of Inks

[8 hours]

Testing of raw materials: pigments, resins; Ink Tests and Measurement: Ink proofing, Tests for color, shade & strength, viscosity, solids content, ink compatibility, ink adhesion test, COF, Rub resistance, Gloss, Mottle, Wet and Dry Abrasion resistance, Testing methods for printing smoothness, ink receptivity, picking and runnability. Quality control for Paste and Liquid inks. Environmental laws for print industry, VOC & its significance in printing inks, Hazardous waste. Environmental effects and control mechanism, Trouble shooting in various printing processes;

Term Work

Term Work shall consist of following TEN experiments:

- 1) Evaluation of Ink Rheology at constant shear rate.
- 2) Evaluation of Ink Rheology at varying shear rate.
- 3) Evaluation of Surface Tension of an Ink on different substrates
- 4) Printability assessment of ink on Offset Proofer.

- 5) Evaluation of relation between viscosity and printability on Gravure Proofer.
- 6) Evaluation of relation between gloss and printability on Flexo Proofer.
- 7) Evaluation of relation between viscosity and print quality on Flexo Proofer.
- 8) Evaluation of Ink Mottle.
- 9) Evaluation of Ink solid content
- 10) Study and demonstration of ink manufacturing.

References:

- 1) Printing Ink Manual; by R. H. Leach & R. J. Pierce
- 2) Apps E. A, Printing Ink Technology, Leonard Hill (Books) Ltd. Efen Street, London, 1958.
- 3) Ronald E.; Printing Inks Pira International Ronald E. Todd, Leatherhead, 1996.
- 4) Chris H. Williams; Printing Ink Technology, Pira International, 2001.
- 5) Dr. Nelson R. Elderred, What Printer Should Know About Ink, GATF Press Pittsburgh, 2001.
- 6) Laden P. O, Chemistry & Technology of Water based Inks, Blackie Academic & Professional

(308290) Seminar and Technical Communication

Teaching Scheme

Practical: 2 Hrs/ Week

Examination Scheme

Term Work: 50 Marks

The seminar report shall be based on material, mainly collected and analysed from research work in the field of printing published in technical and research journals (national and international). The report shall be about 20 pages of A4 size, including figures. The seminar report shall include a certificate, synopsis and references.

The presentation is expected to be in front of audience which must include two internal examiners one of them being the guide. Both examiners shall be University approved teachers. The distribution of marks shall be equally divided between the report and the oral presentation.