FACULTY OF ENGINEERING

Syllabus for the

M. E (Printing Engineering and Graphic Communication)

(w. e. f 2008-2009)

UNIVERSITY OF PUNE
THE SYLLABUS IS PREPARED BY:

BOS- Printing Engineering & Graphic Communication,

University of Pune

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  University of Pune, India

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  Lean Six Sigma Black belt Manager,
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  Buisness Manager,
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Note: - This syllabus is subject to change without prior notice by the concerned BOS
PROGRAMME STRUCTURE

M.E (Printing Engineering & Graphic Communication)
(For 2008 Course) (w. e. f. June – 2008)

SEMESTER I

<table>
<thead>
<tr>
<th>CODE</th>
<th>COURSES</th>
<th>TEACHING SCHEME</th>
<th>EXAMINATION SCHEME</th>
<th>CREDITS</th>
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<tbody>
<tr>
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<td>508101</td>
<td>Probability, Statistics and Queueing Theory</td>
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<tr>
<td>508102</td>
<td>Printing Technology Management</td>
<td>3</td>
<td>-</td>
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<td>508103</td>
<td>Modern Trends in Printing</td>
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<td>-</td>
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<tr>
<td>508104</td>
<td>Elective I</td>
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<td>-</td>
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<tr>
<td>508105</td>
<td>Elective II</td>
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<td>-</td>
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<tr>
<td>508106</td>
<td>Lab Practice I</td>
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<tr>
<td>508107</td>
<td>Seminar I</td>
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## SEMESTER II

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<td>508109</td>
<td>Web Handling on Press</td>
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<td>508110</td>
<td>Substrate and Ink</td>
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<tr>
<td>508111</td>
<td>Elective III</td>
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<td>508112</td>
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**SEMESTER III**

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**SEMESTER IV**

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* The Term Work of Project stage II of semester IV should be assessed jointly by the pair of internal and external examiners along with the oral examination of the same.

**Note** - The Contact Hours for the calculation of load of teacher is as follows: Seminar - 1 Hr / week / student & Project - 2 Hr / week / student

<table>
<thead>
<tr>
<th>Elective 1</th>
<th>Elective II</th>
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<tbody>
<tr>
<td>508104 A</td>
<td>508105 A</td>
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<tr>
<td>Workflow Management in Printing</td>
<td>Digital Printing</td>
</tr>
<tr>
<td>Industry</td>
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<tr>
<td>508104 B Printing and Packaging Materials</td>
<td>508105 B Entrepreneurship in Printing and Allied Fields</td>
</tr>
<tr>
<td>508104 C Design of Experiments &amp; Research Methodology</td>
<td>508105 C Quality Control Systems and Productivity</td>
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<tr>
<th>Elective III</th>
<th>Elective IV</th>
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<tbody>
<tr>
<td>508111 A Multimedia Systems and Communication</td>
<td>508112 A Open Elective (Self Study) **</td>
</tr>
<tr>
<td>508111 B Total Productive Maintenance in Printing</td>
<td>508112 B Advances in Converting and Packaging</td>
</tr>
<tr>
<td>508111 C Press Finger Printing</td>
<td>508112 C Analysis of Spot and Process inks</td>
</tr>
</tbody>
</table>

** Open Elective Subject- BOS Printing Engineering & Graphic Communication will declare the list of subjects which can be taken under open elective.
508101: Probability, Statistics and Queueing Theory

Teaching Scheme:

Lectures: 3 Hrs. / Week

Examination Scheme:

Credits: 3

Theory: 100 Marks


2. Mathematical Statistics – Descriptive statistics like mean, median, standard deviation, percentiles; correlation and regression - interpretation and prediction problems; the normal and binomial distributions; law of averages; sampling variability and standard errors; inferential statistics to confidence intervals and tests of hypotheses for one- and two-sample problems, Multivariate probability distributions, sampling distributions.

3. Regression Analysis – Simple and Multiple linear regression; resolution of fit of a model, including residual analysis, precision of estimation, and tests of general hypotheses; model building; step-wise regression; use of indicator variables; non-linear regression.

4. Statistical Quality Control – Quality, Basis of Control Charts, Types of Control Charts, X & R, U, C, P, NP, I/MR, Zone charts, Control Charts for Variable and Attribute criteria, Acceptance sampling, Use of OC curve

5. Design of Experiments for Quality Improvement – Statistical methods useful for improving the quality of products and systems in an industrial setting. Planning an experiment, experimental strategy, Analysis of Variance concepts, factorial designs, orthogonal arrays, loss functions, signal-to-noise ratios, identifying significant factor effects, graphical methods, parameter design and tolerance design.


**Reference Books**

2. J. K. Sharma, Operation Research-Theory and Application, MacMillan India Ltd., New Delhi
508102: Printing Technology Management

Teaching Scheme:          Examination Scheme:

Lectures: 3 Hrs. / Week          Credits: 3

Theory: 100 Marks

1. Introduction to Print Production and Operations Management – Production, Production systems, Objective of Production Management, Functions and scope print production department, Types of Production, Classification of Production systems, Production planning, Shop floor Management.


4. Inventory Control – Meaning, Types of Inventories, Inventory Control, Inventory Models, Inventory Control system, Selective control of Inventory.


Reference Books

508103: Modern Trends in Printing

Teaching Scheme: Examination Scheme:

Lectures: 3 Hrs. / Week Credits: 3

Theory: 100 Marks


**Reference Books**

7. Steve Doyle, Advancements in Printing Plate Technology, Pira International.
508104 A: Workflow Management in Printing Industry

Teaching Scheme:

Lectures: 3 Hrs. / Week

Credits: 3

Examination Scheme:

Theory: 100 Marks

1. Introduction – Conventional Workflow, Digital Workflow & its significance, Comparison between Conventional and Digital workflow.

2. Types of Workflow – Workflow for Pre-Press to Press, Workflow types and their architecture, Production Module, Conversion to PS or PDF, Job Ticket, Pre-flight checking, Trapping, Proofing, Corrections, Imposition, Image replacement, Ripping, Imaging, Archiving, Conversion.


4. Infrastructural Requirements – Networking, Cabling, Machine configuration requirements, Languages & software’s used in workflow, Platforms, OPI, APR -Servers

5. Integrated Systems – Key elements of integration system such as Electronic Desktop Publishing, Electronic Imposition, Pagination, File Formats such as JDF, PDF, PJTF, CIP 4, PPF, Digital Proof, Inspection & Corrections, and Functions of elements in integrated system.

**Reference Books**

508104 B: Printing & Packaging Materials

Teaching Scheme:  
Lectures: 3 Hrs. / Week  
Credits: 3

Examination Scheme:  
Theory: 100 Marks

1. Materials for Printing – Study of materials for pre-press films used for image-setter, plates used for plate-setter, chemicals used for processing of plates, light sources used such as laser, UV etc, plating chemicals for Gravure cylinders such as copper chrome nickel etc, plating tanks plating calculations such as current, density, time etc, Different Types of CTP Plates like Thermal, Violet etc.

2. Substrates used for printing and packaging- Paper such as Machine Glazed, Super Calendered, News Glazed, Map litho, Newsprint, Roto-newspaper, Paper properties and its interaction with ink, Plastics such as Polyolefin like Polyethylene, BOPP, properties and application, Manufacturing process for polyolefin, PET, Aluminium foil, Metalized films, Factors to be considered for selecting substrate for package

3. Identification of the materials for printing and packaging – Identifying the materials by tearing, burning and solubility.

4. Testing of materials for printing and packaging – Test on package such as Bursting strength, Puncture resistance, Grammage, Drop test, Mechanical strength, Tensile strength, Modulus of elasticity, Flexural test, Optical test, Chemical test, COF, Bond Strength, Rub resistance, Scratch proof test, Adhesion tape test.

5. Inks used for Print Packaging – Solvent based, PU, Vinyl, PA, NC, Water based, UV inks, Paste Inks, Ink Composition, Ink Ingredients, drying mechanism, Surface Energy.

Reference Books

508104 C: Design of Experiments & Research Methodology

Teaching Scheme:  
Lectures: 3 Hrs. / Week

Examination Scheme:
Credits: 3
Theory: 100 Marks

5. Analysis of Results – Parametric and Non-parametric, descriptive and Inferential data, types of data, collection of data (normal distribution, calculation of correlation coefficient), processing, analysis, error analysis, different methods, analysis of variance, significance of variance, analysis of covariance, multiple regression, testing linearity and non-linearity of model.
6. Report Writing - Types of reports, layout of research report, interpretation of results, style manual, layout and format, style of writing, typing, references, tables, figures, conclusion, appendices.
Reference Books

6. John W. Besr and James V. Kahn, Research in Education, PHI Publication.
508105 A: Digital Printing

Teaching Scheme: 
Lectures: 3 Hrs. / Week

Examination Scheme: 
Credits: 3
Theory: 100 Marks

1. Digital printing technologies: overview of digital printing, electro photography, ink-jet (thermal, piezoelectric, continuous), thermography, computer-to-plate (CTP), computer-to-press (direct imaging DI) etc.

2. Digital Prepress: digital photography, scanners, screening techniques, page description languages-PostScript, PCL, PDF (PDF/X and it's flavors), raster image processor (RIP), workflow integration, color management.

3. Digital Proofing: technologies used for digital proofing, hard proofing, soft proofing, halftones simulation (dot proofing), remote proofing, preflight, SWOP/GRACoL certification for proofing systems.

4. Evaluation of Quality: objective (colorimetric) and subjective (visual) assessment of printing technology (devices), image quality attributes, print quality verification tools, standardization - ISO, SWOP, GRACoL.

5. Variety of Applications: customization and direct marketing, Print-on-Demand (POD), variable data printing (VDP), distribute-and-print, remote publishing (Web2Print), wide-format printing, specialty applications (particularly of inkjet) like 3D printing, printing on microscopic items etc.

6. Trends in Digital Printing: evolution of technologies, current market share of different technologies, promising developments (e.g. Xerox iGen3, HP Z-series inkjet printers with in-built spectrophotometer etc), future trends, eco-friendliness
Reference Books

508105 B: Entrepreneurship in Printing & Allied Fields

Teaching Scheme:        Examination Scheme:

Lectures: 3 Hrs. / Week       Credits: 3

Theory: 100 Marks

5. Market Study – Enterprise management, Market research, Management of resources including human resources, Management of technology & innovations, customer relations, Issues related to sourcing & Dealing in the finance payments & receivables, globalization of print, working with overseas customers, different business cultures across the globe, soft skills.
6. Legal Aspects – Laws related to employment, Taxes, Excise, Customs, Power, Communication, Utilities & infrastructure facilities, Valuation, Contracts & Negotiations, Export Zones & Technology
**Reference Books**

508105 C: Quality Control Systems and Productivity

Teaching Scheme:

Lectures: 3 Hrs. / Week

Examination Scheme:

Credits: 3

Theory: 100 Marks

1. Introduction – Understanding Pre-Press, Printing Processes such as Offset, Flexo, Gravure, and Post-Press, Pre-Press requirements for the processes, Process configurations, Process Variables.


3. Quality Control in Printing – Density, Dot gain, Contrast, Trap, Color deviation, Color Variation, Quality control aids in Printing, Automatic Viscosity controller, Auto registration marks, Trakatron Line, Color Spaces, Gamuts, CIE LAB


5. Statistical Print Process Control – Process, Variations, Types of Variation, implementation of SPC, Control Charts and its types, Use of Control charts for print application, Control charts for variables, Control charts for attributes

Reference Books

4. SWOP Publication.
508106: Lab Practice I

Teaching Scheme:  
Practical: 6 Hrs. /Week

Examination Scheme:  
Credits: 3
Term Work: 50 Marks

**Term Work**

The Term Work shall consist of 10 experiments as under:

1. Study & Observation of Plate mounting systems of a Press.
2. Study & Observation of Pressurization system of a Press.
3. Study & Observation of different drive systems of a Press.
4. Study of different Gravure Cylinders.
5. Study of Hybrid Presses.
6. Study of Normality Test for a Press.
7. Study of Print Performance through Histogram plot.
8. Analysis of Statistical data by Control Charts.
9. Analysis of Printing Plate and Film.
508107: Seminar I

Teaching Scheme:
Practical: 4 Hrs. /Week

Examination Scheme:
Credits: 2
Term Work: 50 Marks

Each student is required to deliver a seminar in first semester on state of art of the topic of his/her own choice. The topic of the seminar should be out of the syllabus and relevant to the latest trends in Printing Engineering. The student is expected to submit the seminar report in standard format approved by the University of Pune.
508108: Print Media Communication

Teaching Scheme:  
Lectures: 3 Hrs. / Week

Examination Scheme:  
Credits: 3
Theory: 100 Marks

1. Introduction to various methods for surface designs with the focus on technical skill and discipline.
2. Professional practices in competitive and challenging field of surface design. skills used in creating and exploring technical and production design, for paper and board, textiles, ceramics, glass and plastics.
3. Developing knowledge and solving problem in the field of creative media production including computer aided design, drawing, photography, screen printing. Giving emphasis on developing disciplined approach to design process, considering color and possible product range co-ordinates for final production.
4. Book design and production, study covering book typography from continuous text to reference and integrated titles. Applications of desk top publishing, treatment of illustration, covers and jackets, costing, estimating and production theory of printing
6. Standard format verses tabloid format page sizes, column width and the space between columns. Use of computer in creating design for newspaper pages. 
Application of printing design concept, Application of digital technology as a tool for creating visual solutions to printing design problems, emphasis given to arrangement of typographic and pictorial elements to illustrate and expand the concepts. Study of appropriate digital software, incorporating typographic makeup
Reference Books

4. IFRA publications
5. RIND survey publications
508109: Web Handling on Press

Teaching Scheme:          Examination Scheme:

Lectures: 3 Hrs. / Week   Credits: 3

Theory: 100 Marks

1. Web Viewing & Splicing Systems – Stroboscope, Video viewing, purpose, working and functions, Splicing mechanism for web presses such as gravure, flexo, offset etc.
2. Treatment Systems on Web – Preconditioning of web, corona treatment, working & purpose of corona treatment, measurements for treatments-dyne level requirements for different applications, flame treatment, antistatic eliminators.
3. Web Tension Control – Tension Zones, 3 zonal concepts: unwind tension zone, intermediate tension zone & rewind tension zone and 4 zonal concepts: unwind tension zone, in-feed tension zone, printing tension zone & rewind tension zone, Tensioning devices such as Brakes & Clutches, Load Cells, Dancer Rollers and factors influencing web tension.
4. Register Control – Purpose, Lateral & Circumferential Register control by web movement and cylinder movement, Use of compensator roller for circumferential registration, cylinder grading, register marks & its specification, automatic register control by scanning register marks on moving web.
6. Web Transport Roller- Purpose, Covering used, roller tolerances, wrap angle, lead-in-lead out rollers, specifying the diameter of web transport roller, deflection of roller, measurement & calculation.
**Reference Books**

1. Introduction – Brief survey of pulping technology and processes of manufacturing paper and various other substrates like flexible packing materials, importance of recycling of substrates, FSC, Green Printing, Different types of paper & plastic substrate used for printing, Polymer Technology, Polymer structure for various application, Environmental issues, Paper sizes in metric & English units, Bio-degradable substrate and its characteristics.

2. Selection criteria of substrate – Paper and Plastic substrates for printing, Quality of paper and plastic substrates, Problems arising in printing processes due to the various defects in paper and plastic substrates. Testing methods such as physical, mechanical, optical and chemical properties of paper and plastic substrates with reference to ASTM & TAPPI standards required for printing, packing & computer stationery.

3. Ink requirements – Brief study of various printing techniques with reference to the printing ink quality requirements, raw materials used and technology of printing ink manufacturer for different types of inks, Ink formulation principles and raw material, Different drying mechanisms including UV curing EB curing, Study of formulation composition of litho, flexo, gravure & screen printing inks with reference to the essential properties required.

4. Speciality Inks – Special types of printing inks such as Metallic inks; Water based inks, ink jet printing inks, electrographic inks, security and special effect printing inks, Thermographic, Scented, Fluorescent, Decorative Product Inks.

5. Costing – Cost estimation & cost systems study for understanding costing of various printing & converting jobs with reference to paper and plastic substrates.

Reference Books

8. Reger V. Dickerson, War or Waste, Graphic Communication Association Alexanderia, Virginia.
11. Technical Association for Pulp and Paper Industry, Atlanta, U. S.
50811 A: Multimedia Systems & Communication

Teaching Scheme:                  Examination Scheme:
Lectures: 3 Hrs. / Week           Credits: 3
Theory: 100 Marks

1. Latest developments in multimedia, video, television graphics, animated television graphics, collaboration of different media such as audio, video & animation, authoring.
2. Images in multimedia, digital imaging, image editing, introduction to oops, applying object design to animation process, interactive devices, types of monitors, light pens.
3. Multimedia standards, formats, compression techniques, streaming media, interactivity, recording, editing, morphing.
5. Web basics, web publishing, Programming languages such as HTML, DHTML, XML for web page creation, front page software used for creation of web page, internet addresses, IP addresses, protocol and layering, Blogging, Chatting, Mobile communication Systems, Browser and security, search engines, bookmarks.
6. Digital Camera Work, Resolution, Color, Camera Raw, Capturing for Press & online, Meta data & Asset management.

Reference Books

508111 B: Total Productive Maintenance in Printing

Teaching Scheme: Examinations Scheme:

Lectures: 3 Hrs./Week Credits: 3

Theory: 100 Marks


2. Autonomous Maintenance – Mission, Target, 5S, Routes of Autonomous Maintenance such as initial cleaning, eliminating sources of dirt, inspection & lubrication standards, General inspection, Autonomous inspection, Standardization & Autonomous Management.

3. Focus Improvement – Mission, Target, Effect of Focus Improvement, Overall Equipment Efficiency, Histogram, Pareto Analysis, Brainstorming, Data Collection, Routes of FI to overcome Losses such as Process Waste, Set-Up Waste, Productivity Waste, Short-Stop & Speed Loss.

4. Planned Maintenance – Mission, Target, Routes for Planned Maintenance such as Understanding & Restoring Basic conditions, Maintenance Informative System, Periodical Maintenance, Predictive Maintenance such as Lubricant analysis, Vibration Analysis, Web Break, Noise monitoring, Evaluation of Planned Maintenance, Breakdown Reduction & Analysis for Pre-Press, Press & Post-Press, Mean down Time Reduction, Methods to increase Life-span of spare parts.

5. Quality Maintenance – Mission, Target, Press Optimization & Standardization, Methods for Defect Reduction, Over usage Reduction, Statistical Process Control, Control Charts for subgroups, individual, Run Chart, Runs Test, Quality Tools such as Cause & Effect Diagram, Capability Analysis.

Reference Books

8. J. K. Sharma, Operation Research-Theory and Application, MacMillan India Ltd., New Delhi
1. Introduction – Standardization, Need for Standardization, Understanding Fingerprinting, Characterization & Optimization Facts, Benefits such as Time, Materials, Efficiencies, Capabilities, Requirements of a Pre-Press such as Design considerations.

2. Press Optimization – Understanding Press Variables such as Speed, Pressure, Viscosity, Ink Temperature, Plates, Cylinder cell structures, stylus angle, Inks, Substrates, Press Optimization Procedures, Density, Dot gain, Contrast, Trap, Hue error, Gray balance, Color deviation.

3. Elements for Evaluation – Materials required for evaluation such as Densitometer & Spectrophotometer, IT-8, ECI 2002 charts, Registration marks, Slur Target, Color Control Strip, Ugra Step Wedge, Flag marks, Balls and Beads, Tracker line, Positive and Reverse text/type, Vignette, Gray scale, Hair-line elements and images for evaluation, Test Forms for Flexo & Letterpress, Viewing conditions.

4. Standardization Essentials – Implementing the Process such as Define, Specifying color targets & Product requirements, ICC Profiling, Plan & Run Standardization Test for capabilities and optimization, Characterize, Maintaining Consistency.

5. Post Fingerprinting – Analysis of results, Profile editing, white point of substrates, workflow setup and management of color reproduction systems, Profiling, Profile Maker Packaging, Bump Curves & their Application.

6. Statistical Techniques for Variables – Short-Term & Long-Term Variation, Sample & Analyze the data, Control charts for subgroups, individuals & attributes, Run chart, Process stability and Process capability
Reference Books

508112 B: Advances in Converting and Packaging

Teaching Scheme:  
Lectures: 3 Hrs. / Week  

Examination Scheme:  
Credits: 3  
Theory: 100 Marks

1. Introduction – Principles, Modern developments in converting style, online integrated machines using CIP3, CIP4, inline printing & converting machines for various applications such as die-cutting, punching, labels, Holograms & its importance in Packaging.

2. Finishing technique – Advancement in loose leaf and adhesive binding, stationery and publication binding, integrated machines for finishing and packaging, Embossing, Coatings and Varnishing.

3. Converting Technique – Adhesives for converting and packaging, Lamination techniques such as Dry lamination, Wet lamination, Thermal, Hot-Melt, Extrusion, Solvent-less lamination and its benefits over solvent based lamination, Faults in Lamination & its Remedies, Surface treatments such as Corona, Flame & its importance in Printing and Packaging.


5. Various forms of pouches – Stand-up Pouches, Bag in Box for solid and liquid, Packages for food products, Microwave packaging, PET bottles for food packaging.

Reference Books

1. T. J. Tedesces, Binding, Finishing and mailing, The final Word, GATF Publication, 1999
5. Modified Atmosphere Food Packaging by Aaron Brody, PIRA Publication.
508112 C: Analysis of Spot & Process Inks

Teaching Scheme:        Examination Scheme:

Lectures: 3 Hrs. / Week       Credits: 3

Theory: 100 Marks

1. Introduction – Purpose, Classification, Oil Inks, Heat-set Inks, Moisture Set Inks, Solvent Inks, Water Inks, Curable Inks, Specialized Inks.
3. Rotogravure Inks – Colorants, Vehicles, Solvents, Ink Additives, Publication Gravure Inks, Packaging & Product Inks, Water base Inks, Ink Rheology & Surface Energy, Properties of Inks such as Flow, Resin Solubility, Evaporation Rate, pH control, Engravings, Press Considerations, Thixotropy, Dispersion, Vinyl Inks, Polyamide Inks, Nitrocellulose Inks, Polyurethane Inks, Speciality Inks, Selection criteria of Resins.
4. Offset Inks – Ink Ingredients such as Pigments, Resins, Vehicles, Plasticizers, Additives, Ink Dispersion, Ink Rheology & Ink variables, Different types of offset inks and differences between inks for publication, packaging and product printing.
**Reference Books**

Term Work

The Term Work shall consist of 10 experiments as under:

1. Study of Color Management Softwares.
3. Images for Web using Image Ready.
4. 2D- Animation for web using Flash.
5. Study of Computer to Plate Technology.
7. Study of Spot & Process Inks.
8. Study & Observation of Registration Control of a Press.
9. Study & Observation of Web Tension Control of a Press.
10. Study & Observation of Web Viewing Systems of a Press.
<table>
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<tr>
<th>Teaching Scheme:</th>
<th>Examination Scheme:</th>
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<tbody>
<tr>
<td>Practical: 4 Hrs. /Week</td>
<td>Credits: 2</td>
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<td>Term Work: 50 Marks</td>
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The student is required to deliver a seminar in second semester on the topic relevant to latest trends in Printing Engineering preferably on the topic of sub specialization based on the Electives selected by him/her. The student is expected to submit the seminar report in standard format approved by the University of Pune.
508115: Seminar III

Teaching Scheme:                        Examination Scheme:
                                                                
Practical: 4 Hrs. /Week                  Credits: 2
                                                                
Term Work: 50 Marks

The Term Work will consist of a report prepared by every student on a seminar topic on Advancement in Technology related to the selected dissertation topic or topics closely related to dissertation and oral presentation. The student is expected to submit the seminar report in standard format approved by the University.
Project Stage – I is the integral part of the dissertation project. The project should be based on the knowledge acquired by the student during the coursework and should contribute to the needs of the society. The project aims to provide an opportunity of designing and building complete system or subsystems in an area where the student likes to acquire specialized skills.

The student shall complete the part of the Project that will consist of problem statement, literature review; project overview, scheme of implementation (block diagram, PERT chart, etc.) and Layout & Design of Setup.

The student shall submit the report of Project work completed partly in standard format approved by the University.
508117: Project Stage-II

Teaching Scheme:  
Practical: 18 Hrs. /Week

Examination Scheme:  
Credits: 12
Term Work: 150 Marks
Oral: 50 Marks

The Project Stage-II will be evaluated on the basis of –

1. Physical inspection of the project in case of hardware project.
2. Analysis & Validation of Result
3. Project Report
4. Oral examination

Note: Term-work will be assessed jointly by a pair of internal and external examiners along-with the oral examination of the same.