

CIRCULAR :-

A reference is invited to the Ordinances, Regulations and Syllabi relating to the Bachelor of Engineering degree course vide this office Circular No.UG/401 of 2003, dated 19th August, 2003 and the Principals of the affiliated colleges in Engineering are hereby informed that the recommendation ~~was~~ made by the Faculty of Technology at its meeting held on 5th April, 2007 has been accepted by the Academic Council at its meeting held on 13th April, 2007 vide item No.4.27 and that in accordance therewith, the syllabi for the Second Year-(Sem.III and IV) (Printing and Packaging Technology) is as per Appendix and that the same will brought into force with effect from the academic year 2007-2008.

MUMBAI-400 032

30th May 2007

for I/c. REGISTRAR

To, The Principals of the affiliated colleges in Engineering

A.C./4.27/13.04.2007

No.UG/ 241 - A of 2007, MUMBAI-400 032 30th May, 2007

Copy forwarded with compliments for information to :-

- 1) The Dean, Faculty of Technology

for I/c. REGISTRAR

Copy to :-

The Director, Board of College and University Development, the Deputy Registrar (Eligibility and Migration Section), the Director of Students Welfare, the Executive Secretary to the Vice-Chancellor, the P.A. to the Pro-Vice-Chancellor, and the Registrar and the Assistant Registrar, Administrative sub-center, Ratnagiri for information.

The Officer on Special Duty and Controller of Examinations (10 copies), the Finance and Accounts Officer (2 copies), Record Section (5 copies), Publications Section (5 copies), the Deputy Registrar, Enrolment, Eligibility and Migration Section (3 copies), the Deputy Registrar, Statistical Unit (2 copies), the Deputy Registrar (Accounts Section), Vidyanaagari (2 copies), the Deputy Registrar, Affiliation Section (2 copies), the Director, Institute of Distance Education, (10 copies) the Director University Computer Center (IDE Building), Vidyanaagari, (2 copies) the Deputy Registrar (Special Cell), the Deputy Registrar, (PRO), the Assistant Registrar, Academic Authorities Unit (2 copies) and the Assistant Registrar, Executive Authorities Unit (2 copies). They are requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to in the above Circular and that no separate Action Taken Report will be sent in this connection. the Assistant Registrar Constituent Colleges Unit (2 copies), BUCT (1 copy), the Deputy Account, Unit V (1 copy), the In-charge Director, Centralize Computing Facility (1 copy), the Receptionist (1 copy), the Telephone Operator (1 copy), the Secretary MUASA (1 copy), the Superintendent, Post-Graduate Section (2 copies), the Superintendent, Thesis Section (2 copies)

original

Enclosure to Item No.

427
13/4/07

UNIVERSITY OF MUMBAI



REVISED SYLLABUS FOR THE

SECOND YEAR – SEM. III & IV

In the Branch of

Printing & Packaging Technology

(With effect from the academic year 2007-2008)

FACULTY OF ENGINEERING

**THE DRAFT SYLLABUS
IN THE BRANCH OF
PRINTING & PACKAGING TECHNOLOGY**

of the

S.E. SEMESTER III & IV

(With effect from the academic year 2007-2008)

Submitted by

The Convener of the Committee appointed by the Faculty of
Technology at its meeting held on 16.03.2007

TO

UNIVERSITY OF MUMBAI



(2)

UNIVERSITY OF MUMBAI
Scheme of instructions & Examination
at
B.E. (Printing & Packaging Technology)

SEMESTER – III

Subjects	No. of Periods per Week (60 minutes each)			Duration of Theory Paper (Hrs)	Marks				
	Lectures	Practicals	Tutorials		Theory Paper	Term Work	Practical	Oral	Total
Applied Mathematics – III	04	--	02	03	100	25	--	--	12
Packaging Introduction & Concepts	03	02	--	03	100	25	--	--	12
Primary Packaging Materials – I	05	02	--	03	100	25	25	25	17
Material Sciences & Strength of Materials	04	02	--	03	100	25	--	--	12
Principles of Control Systems	04	02	--	03	100	25	--	--	12
	20	08	02	--	--	--	--	--	67

SEMESTER – IV

Subjects	No. of Periods per Week (60 minutes each)			Duration of Theory Paper (Hrs)	Marks				
	Lectures	Practicals	Tutorials		Theory Paper	Term Work	Practical	Oral	Total
Applied Mathematics - IV	04	--	02	03	100	25	--	--	12
Primary Packaging Materials - II	03	02	--	03	100	25	--	25	15
Ancillary Packaging Materials	03	--	--	03	100	--	--	--	10
Introduction to Printing Technology	03	02	--	03	100	25	--	25	15
Theory of Machines	04	02	--	03	100	25	--	--	12
Advanced Control Systems	03	02	--	03	100	25	--	--	12
	20	08	02	--	--	--	--	--	77

Periods per week
 1 period of 60 min.

Lecture
 Practical
 Tutorial

04

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02

Evaluation System

Theory Examination
 Practical
 Oral Examination
 Term Work

Hours

3

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--

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Marks

100

--

--

25

Detailed Syllabus

UNIT - I	Complex Variable	Periods	Weight
	Functions of complex variable. Continuity (only statement) derivability of a function, Analytic, Regular function. Necessary conditions for the function to be analytic. (Statement of sufficient conditions). Cauchy Riemann equation in polar co-ordinates. Harmonic functions, orthogonal trajectories, Analytical & Milne Thompson method to find $f(z)$ from its real or imaginary parts. Mapping: Conformal mapping, linear, bilinear mapping with geometrical interpretations.	14	25%
Unit - II	Vector Calculus Scalar and vector point functions, Directional derivative, Level surfaces, Gradient. Surface and volume integrals. Definitions of curl, divergence. Use of operator. Conservative, Irrotational, Solenoidal fields.	10	15%
Unit - III	Laplace Transforms Function of bounded variation (statement only) Laplace transforms of $1, t^n, e^{at}, \sin(at), \cos(at), \sinh(at), \cosh(at)$, shifting properties expressions (without proofs) for unit step functions and their Laplace transform. Laplace transform of periodic functions. Application to solve initial and boundary value problems involving ordinary differential equations with one dependent variable.	14	25%
Unit - IV	Matrices Types of matrices. Adjoint of a matrix. Inverse of a matrix. Elementary transformation rank of a matrix. Linear dependent and independent of rows and columns of a matrix over a real field. Reduction to a normal form. Partition of matrices. System of homogenous and non-homogeneous equations their consistency and solution. Brief revision of vectors over real field inner product, norm, linear independence, orthogonality. Characteristic values and vectors and their properties for Hermitian and real symmetric matrices. Characteristic polynomial	18	35%

Term Work:

Each student has to appear for at least one written test during the term. At least 10 assignments covering the entire syllabus along with a graded answer paper shall be submitted as term work.

The distribution of term work will be as follows:

Report on assignments – 15 marks

Written test – 10 marks

Text Books

- A text book of Applied Mathematics I & II : P.N.Wartikar and J.N.Wartikar, Vc (Pune Vidyarthi Gruha Prakashan)
- Matrices : Vasistha.A.R(khanna Publications)
- Complex Variables and Applications : Churchil R.V. & J.W.Brown(Mc Graw Hill)
- Schaum's outline of theory and problems of Laplace Transforms - M.R.Spiegel (Mc Graw Hill)
- Schaum's outline of theory and problems of Vector Analysis & Introduction to Tensor Analysis – M.R.Spiegel (Mc Graw Hill)

Reference Books

- Engineering Mathematics : S.S.Sastry, (Prentice Hall of India)
- Basic Mathematics for college students : Alan Tussy, R.David Gustafson(Books Cole)

S.E (Printing & Packaging Technology)
Subject : Packaging Introduction & Concepts

		Semester - III	
Periods per week (1 period of 60 minutes)	Lecture	3	
	Practical	2	
	Tutorial	--	
Evaluation System		Hours	Marks
	Theory Examination	3	100
	Practical	--	--
	Oral Examination	--	--
	Term Work	--	25
	Total		125

Detailed Syllabus		Periods	Weightage
UNIT - I	PACKAGING INTRODUCTION, PURPOSE AND OBJECTIVE • Packaging – The industry overview (Domestic) – type, set- up, packaging material consumption, industry pattern. • Packaging – The industry overview (Global) global consumption of packaging, region wise, per capita consumption. • Packaging – definition and classification, packaging terms, purpose, objectives, types of packages. • Packaging – Laws & Regulations • Packaging and Environment	08	20%
UNIT - II	PACKAGE – DESIGN APPROACH • Product-Packaging relationship–Product–Package characteristics, compatibility factors, product type Vs packaging requirements. • Product characteristics– Physical: state, centre of gravity, size / weight, volume. • Product characteristics–Chemical: effect of gases, Moisture, atmospheric gases. • Product characteristics – Biological: sensitivity to microbial factors. • Product characteristics – Physico chemicals: effect of moisture vapour, oxygen & other gases.	08	20%

Detailed Syllabus

UNIT - III	PACKAGING MATERIAL CHARACTERISTICS	Periods 09	Weightage 20%
	• Packaging Material Properties – Physical : Influence of molecular / fibre directions, Tensile, Breaking load, Tension, Tear, Torsion, Puncture, Burst. • Packaging Material Properties – Chemical : pH, chloride / sulfate content, Imbedded and unreacted chemicals. • Packaging Material Properties – Biological : sensitivity to microorganisms. • Packaging Material Properties - Physico Chemical: absorption & diffusion of moisture and gases – Barrier properties.		
UNIT - IV	PACKAGING MATERIALS EVALUATION	09	20%
	• Physical & Mechanical Properties: weight, dimensions, strength properties, stiffness, Tear, Tensile and others. • Chemical properties: Alkalinity, Acidity, Resistance • Biological properties: Sensitivity to Microbes, chemicals, presence of chloride, sulfate, lignin, Ash, flammability. • Physiological properties – odour / flavour.		
UNIT - V	PACKAGE EVALUATION / PACKAGING CONTAINERS (UNIT / RETAIL)	08	20%
	• Flexible packages (Unit / Retail) – Resistance to drop, vibration, pressure, etc. • Flexible bulk packages – Drop Impact, seal / seam strength, Breaking load. • Rigid bulk packages – Mechanical / Climatic hazards – Vertical / Horizontal drops / Vibrations / Compressions / Rain / Humidity / High and low heat. • Ancillary packaging materials – Shear strength, Tensile, bending resistance, peel.		

Practicals: List of Experiments

1	Assessment of Product Characteristics – size, volume (Nominal / brimful), weight, centre of gravity, viscosity, etc. (Physical / Mechanical)
2	Assessment of Packaging Material Properties – weight, grammage, Tensile / Tear / Elongation, pH, chloride / sulfate content, Ash, Stiffness, Puncture, Burst. (Physical / Mechanical / Chemical)
3	Assessment of Ancillary Materials properties – Coating Wt, Shear strength, Tensile & Elongation, Viscosity, Solid content.
4	Package Evaluation (Mechanical & Climatic) – Drop / Vibration / Compression/ Impact resistance. Effect of rain, Salt spray, sand & dust, Variation in Humidity, etc.

Term Work:

Each student has to appear for at least one written test during the term. Report on Laboratory experiments along with a graded answer paper shall be submitted as term work.
 The distribution of term work will be as follows:
 Report on experiments – 15 marks
 Written test – 10 marks

TEXT BOOKS

- Fundamentals of Packaging Technology – F.A. Paine (Blackie & Sons publication)
- Packaging Materials and containers – F.A. Paine (Blackie & Sons publication)
- Plastics in Packaging – A.S. Athalye, Tata McGraw Hill, New Delhi
- Plastic Packaging- Susan E.M. Selke (Hanser Gardner Publication)

Reference Books

- Packaging Technology - correspondence course Vol. 1 & 2 – South Africa Packaging Institute.
- Certificate in Packaging Technology Module one – Packaging Principles & Practice Hand book Nos. one, two and three, J.H.Byett, The Institute of Packaging
- Hand book of Package Engineering: Joseph F Hanlon, Robert J. Kelsey, Hallie E. Forcirio
- Export Packaging Manual on Wooden Packaging. ITC Unctad / GATT Geneva
- Packaging Materials & Containers, F.A. Paine (Blackie & Sons publication)

Reference Books – continued :

- Fundamentals of Packaging Technology - Walter Soroka, Institute of Packaging Professionals / IOPP
- Hand book of Packaging Technology, John Byett
- Packaging users hand book Edited by FA PAINE: The Institute of Packaging, U K.
- Handbook of Plastics Indian, Y.B.Vasudeva, Indian Plastics Institute
- Plastic Material Hand book – A.S. Athalye, Multi Tech. Publishing Company.

REFERENCE STANDARDS:

IS 1060 BIS, New Delhi	PART I, II, III Reaffirmed 1992 Part – 1 : Methods of sampling and test for paper allied products : Part – 1 (Revised) Reaffirmed 1997 Part – 2 : 1960 – Methods of sampling and test for paper allied products: Part -2. Reaffirmed 1992 Part – 3 : 1969 – Methods of sampling and test for paper allied products : Products : Part – 3
IS 4006 BIS, New Delhi	PART I, II, III Reaffirmed 2002 Part –1 : 1985 – Methods of test for paper and Pulp Based Packaging Materials, Part –1 (First Revision) Reaffirmed 2002 Part – 2 : 1985 – Methods of test for Paper and Pulp Based Packaging Materials, Part – 2 (First Revision) Reaffirmed 2002 Part – 3 : 1985 – Methods of test for Paper and Pulp Based Packaging Material , Part – 3 (First Revision)
ASTM, USA	American Society for Testing and Materials 100 BARR HARBOR DRIVE, PO BOX C700, WEST CON SHOH OCKEN, PA 19428 – 2959 TEL : 610 - 832 – 9500 Fax : 610 – 832 – 9555 Email : service@astm.org . Website : www.astm.org .
BSI, U.K.	British Standards Institution BS 1133 Packaging Code.
FIN STANDARDS Finland	World – Wide association for self-adhesive labels and Related Products. The Hague – Netherlands Tel : +31 – 7031239 10 , Fax : +31 – 70 3636348 Email : info@finat.com , Website : www.finat.com
TAPPI, USA	Technical Association of the Pulp and Paper Industry TAPPI Technology Park / Atlanta P.O Box 105113 Atlanta, GA 30348 – 5113 USA.

SE (Printing & Packaging Technology)		Semester - III	
Subject: Primary Packaging Materials - I			
Periods per week 1 period of 60 min.	Lecture	5	
	Practical	2	
	Tutorial	--	
Evaluation System		Hours	Marks
	Theory Examination	3	100
	Practical	--	25
	Oral Examination	--	25
	Term Work	--	25
	Total		175

Detailed Syllabus		Periods	Weightage
UNIT - I	Pulp / Paper / Board / Speciality Papers • Manufacture of pulp & paper - chemical process, properties and applications • Manufacture of pulp & paper - Mechanical process, properties and applications • Specialty papers : conversion types, properties / applications • Production of paperboard / coated boards, types / varieties / applications. • Regenerated Cellulosic Films.	15	22%
UNIT - II	Folding Board / Corrugated / Solid Board Boxes & Multiwall Paper Sacks. • Folding board Cartons, styles, varieties & conversion technologies • Corrugated / solid boards – conversion of board / box, designs • Paper pouches: varieties, • Multiwall bags / modifications – selection and applications.	15	22%
UNIT - III	Metals In Packaging • Metal packaging – MS, GI, Tinplate, Tin Free steel • General descriptions & Conversion Technologies / Applications • General purpose can, OTS can, can lids including easy open • Lacquered cans – selection of lacquers. • Two / Three pc cans, seaming, welding and cementing technologies • Metal packaging – Aluminum (slugs, foil and sheet) • Conversion Technologies, forms and applications	15	22%

Detailed Syllabus

		Periods	Weightage
NIT - IV	Glass In Packaging/Composites In Packaging - Glass – types of glass, forms and areas of applications. - Forming Technology – Manual, Semiautomatic, Automatic process - Composite containers – production (convolute / spiral / lap) processes, leak proof composites – forms / types and end uses.	09	12%
NIT - V	Textiles / Jute In Packaging - Jute and Textiles / Jute & Hemp fiber - Conversion process – yarn to fabric to bag - Fabric & bag modification – process - End use applications	08	11%
NIT - VI	Wood & Plywood In Packaging - Wood and Plywood - Wood – Types / classification. - Conversion of wood to cases & crates - Styles of wooden case / crates - Manufacture, Varieties and conversion process and Application - Defects in wood, Jointing / nailing pattern - Wood preservation and treatment	08	11%

Practicals: List of Experiments

1	Testing of specialty papers, grease proofness, oil penetration, surface properties
2	Moisture in Wood; testing of joints / Effectiveness of treatment
3	Lateral and vertical compression of composites / Tin plate cans
4	Lacquer analysis in Tinplate containers, Tin coating
5	Corrugated board / box – physical / mechanical properties, Box performance – compression and stack load.
6	Alkalinity of glass, Heat resistance of glass, verticality of glass. Hydrostatic pressure of bottle
7	Jute / textile – yarn / fabric / bag – denier, Breaking load, seam strength, drop

Term Work:

Each student has to appear for at least one written test during the term. Report on Laboratory Experiments along with a graded answer paper shall be submitted as term work.

The distribution of term work will be as follows:

Report on experiments – 15 marks

Written test – 10 marks

TEXT BOOKS;

- Pulp and paper : Casey, Vol -1, 2 & 3.
- Packaging Materials and Containers – F.A. Paine (Blackie & Sons publication)
- Cartons and Corboring – D J. Hine. Pira International Surrey, U.K.
- Paper & Paper board in Packaging – Mark J. Kirwan, Blackwell Publication
- Introduction to flexible packaging – Angadike.
- Wood & Cellulosic Chemistry – David .S. Hon, Marcel Dekker, Inc

Reference Books

- ASTM, D2383 – D4322 / D256 – 2343.
- Glass in Packaging – I I P.
- Cellulose & Cellulosic Films in Packaging – I I P.
- Tinsplate & Aluminum in Packaging – I I P.
- Hand book of Plastic Films – Elsafyed M Abdel - Bary, Rapra Technology Ltd.
- Hand book of corrugated board box, - A reference pantone printing press

S.E (Printing & Packaging Technology)		Semester - III	
Subject: Material Sciences & Strength of Materials			
Periods per week 1 period of 60 min.	Lecture	4	
	Practical	2	
	Tutorial	--	
Evaluation System		Hours	Marks
	Theory Examination	3	100
	Practical	--	--
	Oral Examination	--	--
	Term Work	--	25
Total			125

Detailed Syllabus		Periods	Weightage
Unit - I	Simple Stress and Strain: Stress, Strain, modulus of elasticity, modulus of rigidity, bulk modulus, yield stress, ultimate stress, factor of safety, shear stress, Poisson's ratio, bars of varying sections, composite sections, temperature stresses.	06	10%
Unit - II	S.F and B.M in beams: Axial force, shear force and bending moment diagrams for statically determinate beams including beams with internal hinges for different types of loading, relationship between rate of loading shear force and bending moment.	07	12 %
Unit - III	Simple Theory of Bending: Flexure formula for straight beams, Moment of Inertia, Product of Inertia and Polar moment of Inertia of plane areas, principal axes of inertia, moments of inertia about principal axes transfer theorem, simple problems involving application of flexure formula, section modulus, moment of resistance of a section.	08	15%
Unit - IV	Shear Stress in beams: Distribution of shear stress, across plane sections used commonly for structural purposes, shear connectors, shear stresses and flow in beams of thin walled open cross sections, shear center of thin walled sections such as angle, Tee channel and I - Section.	06	10%
Unit - V	Simple theory of torsion: Torsion of circular shafts - solid and hollow, stresses in shaft when transmitting power, close-coiled helical springs under axial load.	06	10%

Detailed Syllabus

Unit - VI	Bending moment combined with Torsion and axial loads: Application to members subjected to eccentric loads, core of a section, problems on chimneys, shaft etc.	Periods 06	Weightage 10%
Unit - VII	Deflection of beams: Deflection of cantilevers, simply supported and overhanging beams using double integration and Macaulay's methods for different types of loadings.	08	15%
Unit - VIII	Strain energy: Strain energy due to axial force and bending moment, stresses in axial members and simple beams due to impact loading.	05	09%
Unit - IX	Stress and strain in thin Cylinders and spheres due to internal pressure	04	09%

Practicals -List of study Experiments as per Indian Standards

- Tension test on mild steel bar (stress – strain behavior, modulus determination)
- Test on tor-steel bar (tension, bend & re-bend)
- Test on cast iron (transverse, tension)
- Shear test on mild steel, cast iron, brass
- Torsion test on mild steel bar/cast iron bar
- Flexural test on beam (central point load)

Term Work:

Each student has to appear for at least one written test during the term. Report on Laboratory study Experiments along with a graded answer paper shall be submitted as term work.

The distribution of term work will be as follows:

Report on Study experiments and assignments if any – 15 marks

Written test – 10 marks

Text Books:

- | | |
|-------------------------------|---|
| • Mechanics of Materials | E.P Popov, Prentice Hall of India |
| • Theory of Elastic Stability | Timoshenko & Gere, Tata McGraw Hill |
| • Engineering Mechanics | Timoshenko & Young, Tata McGraw Hill |
| • Mechanics of Structures | S B Junnakar, Vol. I, Charotar Publishers |

Reference Books

- | | |
|--------------------------|---|
| • Mechanics of Materials | James Gere-Thomson Learning |
| • Mechanics of Material | Ferdinand P Beer, E Russell Johnston, |
| | Jr. John T dewolf McGraw Hill International |
| • Strength of Materials | S Ramamarutham |

S.E (Printing & Packaging Technology)
Subject: Principles of Control Systems

Semester - III

Periods per week
 1 period of 60 min.

Evaluation System

S.E (Principles of) Subject: Principles of Periods per week 1 period of 60 min.	Lecture	4	
	Practical	2	
	Tutorial	--	
Evaluation System	Hours	Marks	
	Theory Examination	3	100
	Practical	--	--
	Oral Examination	--	--
	Term Work	--	25
Total		125	

Detailed Syllabus

		Periods	Weightage
Unit - I	Introduction to Control System Analysis Introduction, examples of control systems, open loop control systems, closed loop systems, Transfer function and impulse response of systems, laplace transform, review, transfer function of electrical network.	05	9%
Unit - II	Control System Components DC and AC servomotors, servoamplifier, potentiometer, synchro transmitters, synchro receivers, synchro control transformer, stepper motors, translational mechanical system transfer function, rotational mechanical system transfer function.	05	9%
Unit - III	Mathematical Modeling of Systems Importance of a mathematical model, Block Diagrams, signal flow graphs, Mason's gain formula and its application to block diagram reduction	05	9%
Unit - IV	Transient-Response Analysis Impulse response function, First order system, second order system, time domain specifications of systems, analysis of transient-response using second order model.	06	10%
Unit - V	Steady-State Error Analysis Classification of control systems according to "Type" of systems, Steady-state errors, static error constants, steady-state analysis of different types of systems using step, ramp and parabolic input signals.	05	9%
Unit - VI	Frequency-Response Analysis Introduction, frequency domain specifications, resonance peak and peak resonating frequency, relationship between time and frequency domain specification of systems	08	15%

Detailed Syllabus

Unit - VII	Stability Analysis	Periods	Weightage
	Introduction to concept of stability, Stability analysis using Routh's stability criterion, Absolute stability, Relative stability and stability using bode plots, polar plots, Nyquist plots and root locus	11	20%
Unit - VIII	Controller Principles		
	Discontinuous controller modes, continuous controller modes, composite controllers	03	5%
Unit IX	State Space Analysis		
	State Space model of an LTI system. Solution of state equation, concept of controllability and observability.	08	14%

Term Work:

The termwork shall consist of atleast ten experiments and assignments based on the whole syllabus duly recorded and graded..

The distribution of term work will be as follows:

Report on experiments and assignments- 15 marks

Written test - 10 marks

Text Books:

- K. Ogata : *Modern Control Engineering*, Prentice Hall of India, 3rd edition
- Benjamin C Kuo, *Automatic Control Systems*, Prentice Hall of India, Seventh edition
- Madan Gopal, *control Systems Principles and Design*, Tata McGraw hill, seventh edition, 1997

Reference Books

- Curtis Johnson, *Process Control Instrumentation Technology*, Prentice Hall of India, fourth edition
- Paul Zbar, *Industrial Electronics - A Text Lab Manual*, Tata McGraw hall, first edition, 1983

SE (Printing & Packaging Technology)		Semester - IV	
Subject: Applied Mathematics - IV		Lecture	4
Periods per week		Practical	--
Period of 60 min.		Tutorial	02
Evaluation System		Hours	Marks
	Theory Examination	3	100
	Practical	--	--
	Oral Examination	--	--
	Term Work	--	25
		Total	125

Detailed Syllabus		Periods	Weightage
Unit-I	Fourier Series and Integrals Orthogonal and Orthonormal functions expression for a function in a series of orthogonal functions. Sine and cosine functions and their orthogonality properties. Fourier's series, Dirichlet's theorem (only statement). Periodic function with Even and Odd functions. Half range sine and cosine series. Complex form of Fourier series. Introduction to Fourier Integral Parseval's identity, Introduction to Fourier transform.	16	33%
	Statistics, Probability and Reliability Frequency distribution, Measures of central tendency, Mean, Median and Mode, Measures of variability, Range, Percentiles, Variance, Standard Deviation, Skewness, Moments, Discrete random variables and their probability distributions, Binomial and Poisson's distributions, continuous random variables, Normal distribution, properties of Normal distribution, coefficient of Correlation, Lines of regression – Rank Correlation, Test of Significance. Theory of probability and reliability.	20	30%
Unit-II	Numerical Methods Solution of simulations equations, Gauss sidel and Gauss elimination methods, Runge Kutta 4 th order and Euler's modified rule, Numerical interpolation, Newton's Forward and Backward Interpolation methods, Lagrange's interpolation formula, Numerical integration, Simpson's rule, Trapezoidal Rule, Gauss quadrature Double Integration techniques, solution of linear and transcendental equations, Newton Raphson method Bisection method, Numerical differentiation, Newton's Forward and Backward difference formula (No derivation is expected, Only application level study is required)	20	37%

Term Work:

Each student has to appear for at least one written test during the term. At least 8 assignments covering the entire syllabus along with a graded answer paper shall be submitted as term work. The distribution of term work will be as follows:

Report on assignments – 15 marks
Written test – 10 marks

Text Books

- Differential Equations – A Systems Approach: Jack Goldberg, Merle C. Potter (Prentice Hall)
- Mathematical Statistics : J.N. Kapur & H.C. Saxena (S. Chand)
- A Text Book of Applied Mathematics : P.N. Wartikar & J.N. Wartikar Vol I & II (Pune Vidyarthi Gruha Prakashan)
- Numerical Analysis : Richard L. Burden, J. Douglas Fairies (Thompson)

Reference Books

- Applied Numerical methods for Engineering using MATLAB & C : Sandra L. Harris, Thomson Learning
- Numerical Methods for Engineers with software and programming Application: Steve C. Chapra, Raymond P. Canale, McGraw Hill International
- Fundamentals of Mathematical Statistics: S.C. Gupta, V.N. Kapoor (S. Chand)
- Probability, Statistics and Random Processes: T. Veerajan (McGraw Hill International)
- Introductory methods of Numerical Analysis : S.S. Sastry (Prentice Hall of India)
- Integral transforms for Engineers: Andrews and Shivamoggi (Prentice Hall of India)

SE (Printing & Packaging Technology)		Semester - IV	
Subject: Primary Packaging Materials - II			
Periods per week 1 period of 60 min.	Lecture		
	Practical		3
	Tutorial		2
Evaluation System		Hours	Marks
	Theory Examination	3	100
	Practical	--	--
	Oral Examination	--	25
	Term Work	--	25
	Total		150

Detailed Syllabus

		Periods	Weightage
UNIT - I	- Polymers and plastics – Introduction - Classification of plastics & differentiation (Thermo plastics / Thermo sets) - Production of Polymers – Polymerisation Reaction (Addition / Condensation, Bulk, Resin, Suspension and solution Polymerisation).	07	17%
UNIT - II	- Polyolefins – Polyethylenes, Polyvinyl Chloride and Polypropylenes - Polyethylene – LLD, LD, MLD, HDPE, HMHDPE, Ultra HD PE- Manufacture, varieties, types, properties & applications. - Polypropylene (PP) – manufacture / modifications, varieties / applications. - Polyvinyl chloride - compounded / uncompounded – need for compounding, process, selection criteria.	07	17%
UNIT - III	- Other Polymers / Plastics : - Polystyrene (PS) – General purpose, rubber modified - Polyamides (Nylons) – varieties, properties, packaging applications. - Polycarbonates, Polyesters – film / bottle grades, manufacture & application - Speciality polymers – PvdC, modified polymers	07	17%
UNIT - IV	- Flexible packaging (laminates) – definition and substrates - Conversion process (Wet, Dry, Solventless, Extrusion and Wax) - Types of laminates. Selection criteria, properties, advantages & applications	07	17%

Detailed Syllabus

UNIT - V	Co- extrusion technology – why and how 2 / 3 / 5 / 7 / 9 / layer films / possible combinations, varieties Vs applications	Periods 07	Weightage 17%
UNIT - Vi	Additives for polymers / plastics – Master batches. Colourants, Antistatics, Antislip, Plastisiers etc.	07	15%

Practicals – List of Experiments

- Identification of Plastics – Physical / Chemical and Instrumentation analysis.
- Testing of plastic containers.
- Migration analysis for leaching characteristics
- Flexible laminates – separation of layers / substrates, Individual and total thickness, Bond strength / seal strength, Tensile, Tear and stiffness tests, Barrier properties – evaluation.
- Testing of pouches – seal strength, burst strength, Vacuum test.
- Shelf life analysis.

Term Work:

Each student has to appear for at least one written test during the term. Report on Laboratory Experiments along with a graded answer paper shall be submitted as term work.

The distribution of term work will be as follows:

Report on experiments– 15 marks

Written test – 10 marks

TEXT BOOKS

- Plastics In Packaging – A. S. Athalye ,Tata McGraw Hill, New Delhi
- Applications of Plastics – Dr. J. S. Anand, Prints India Pvt. Ltd.
- Converting for Flexible Packaging – Adolph Hiller, Technomic Publication, Company, Inc.
- Plastics Film Technology – Kenton R Osbhn & Wilmer A Jenkins, Technomic Publication Company, Inc.

REFERENCE BOOKS

- Plastics Materials Hand book – A. S. Athalye, Tata McGraw Hill, New Delhi
- Willey Encyclopoedia of Packaging Technology –Marilyn Bakker, John Willey & Sons.
- Plastics Technical Booklet – N.C.Dave, Dave Technical Services.

S.E (Printing & Packaging Technology)
Subject: Ancillary Packaging Materials
 Periods per week
 1 period of 60 min.

Semester - IV

Evaluation System	Lecture	3	
	Practical	--	
	Tutorial	--	
		Hours	Marks
	Theory Examination	3	100
	Practical	--	--
	Oral Examination	--	--
	Term Work	--	--
	Total		100

Detailed Syllabus

		Periods	Weightage
UNIT - I	Cushion System – Theory, Application, Design - Cushioning materials – varieties, applications. (Flexible, semi rigids and fillers) - Expanded Polystyrene, Urethanes, Polyethylene, Expanded Rubber, Air bubble films. - Rubberized coir, Corrugated boards and Honey comb boards - Wood shavings, Saw dust, Paper / Cellulosic Shreds - Urethane – 2 component system. - Cushion factor, Cushion design, forms of Cushions	07	16%
UNIT - II	Theory Of Adhesion, And Adhesives – Types / Varieties And Applications - Adhesion – principle, wetting angle. - Natural adhesives – corn, potato, tapioca etc. - Synthetic adhesives – Hotmelt, Acrylics - Animal glue - Mineral adhesives - Adhesives and adhesive strength evaluation - Viscosity / solid contents / wetting / yield etc. - Tensile / shear value, climatic / environmental influences. - Hotmelt and laminating adhesives.	07	16%
UNIT - III	Caps / Closures / Dispensers - Theory and purpose of caps, - Types of closures – RSNP, RS, Twist off – Twist on, - Design features of caps / closures - Wads – Wadding Materials, properties, selection Criteria - Developments in dispensing closures and - New generation dispensing closures.	07	16%

Detailed Syllabus

UNIT - IV	Labels And Labellings	Periods	Weightage
	- Labels – Classification / Types / Varieties / Applications, purpose & objective. - Label stocks – paper, films, Al foil – specifications and applications. - Labels – Wet glue, Pressure sensitive, Shrink sleeve - properties and applications. - Smart and Intelligent Labels / Security labels - Labelling process, equipments and mechanism.	07	16%
UNIT - V	Reinforcement : Principles / Technology / Materials	04	10%
	- Metal straps – types / varieties, application systems. - Tensioning, Crimping / Self sealing mechanisms. - Synthetic / Straps – HDPE / PP / PET / Nylon relative merits and applications methods. - Others – Rayon, reinforced paper.		
UNIT - VI	Lacquers And Coatings And Varnishes – Types, Varieties And Applications – For	06	16%
	- Metal plate / cans - Over print varnishes - Decorative coatings - Lacquers for flexible substrates / Laminates		
UNIT - VII	Other Ancillaries	04	10%
	- Tapes – Cellulosics, BOPP, PVC - Coding & Marking systems – Ink jet inks, - Printers, contact & Non contact Coders, Digital printers		

TEXT BOOKS

- Lacquers, Varnishes and coatings – Kevin P. Pilley, Arthur Holden & Sons Ltd..
- Adhesion and Adhesives Technology An Introduction – Alphonsus V Pocius, Carl Hanser Verlag

REFERENCE BOOKS

- Finat Technical Hand book – FINAT, The Hague, Finat, The Hague
- Closure Guides – Closure Manufacturers Association, Washington, Closure Mfgers Association.
- Industrial Packaging, Walter F Friedman, Jerome J Kipness, John Wiley & son

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Subject: Introduction to Printing Technology		Semester - IV	
Periods per week 1 period of 60 min.	Lecture		
	Practical	3	
	Tutorial	2	
Evaluation System		Hours	Marks
	Theory Examination	3	100
	Practical	--	--
	Oral Examination	--	25
	Term Work	--	25
Total			150

Detailed Syllabus			
UNIT - I		Periods	Weightage
UNIT - I	Printing – History and background, Evolution of printing, Typography – Definition and brief history of printing Letterpress and Lithostone, 2D/3D type, typesetting Technique, Type faces, Fonts, Type, classification, Introduction to DTP, Basic materials used for printing – paper / film/foil & others – significant properties.	06	14%
UNIT - II	Photography – Basics in reprographic Engineering, Line & Half tone photography, special Processing procedures in making halftones, Special half tone camera technique and Digital photography	08	19%
UNIT - III	Introduction to Printing & Printing Technologies. various processes, differences and selection and applications, Letter press, Offset, Graure, Flexography, Screen, Pad printing.	10	24%
UNIT - IV	PRINTING MATERIAL SCIENCES Colloidal, Metal surface Chemistry, Photo Chemistry (photographic emulsion preparations, developers, reducers & intensifiers) A wd / base and buffers and Electro Chemistry.	08	19%

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Detailed Syllabus

UNIT - V	PRINTING INKS	Periods	Weightage
	Introduction, solvent based inks, water based ink, ingredients in ink – pigments – properties, types, carbon black, inorganic pigments, organic pigments, physical characteristics of organic pigments. Vehicles – vehicles for liquid inks, vehicles for paste inks, UV curing vehicles. Additives – driers, extenders, distillates, anti oxidants, waxes. Oils – vegetable drying oils, semi drying oils, non drying oils. Drying mechanisms, physical drying mechanisms, absorption drying, evaporation drying, chemical drying systems, oxidation polymerization drying, radiation drying and curing, microwave drying, infrared drying. Accelerated ink drying. Viscosity – Newtonian flow, units of viscosity, viscosity & temperature, factors influencing viscosity, simple low viscosity inks, complex high viscosity inks. Ink requirements for printing processes – offset, letterpress, flexography, gravure, screen printing. Optical properties of ink films, rheology and ink transfer requirements, ink distribution and transfer on the press, new method for the direct measurement of ink setting on coated paper. Printing Ink manufacturing machines & equipments. Paste inks – single roll mill, twin roll mill, triple roll mill, ball mill, twin horizontal mixer, uni – roll mill, high speed stirrer milling. Liquid inks – ball mill, pearl mill, sand mill, bead mill, shot mill. Trends and developments in ink manufacturing process.	10	24%

Practicals: List of Experiments

- Introduction to Computer, Hardware basics, software related to Printing Technology
- Introduction to Camera
- Print evaluation and assessment of print
- Properties of substrates and printed Materials
- Study of Printing Machines

Term Work:

Each student has to appear for at least one written test during the term. Report on Laboratory Experiments along with a graded answer paper shall be submitted as term work.

The distribution of term work will be as follows:

Report on experiments and assignments– 15 marks

Written test – 10 marks

TEXT BOOKS / REFERENCES

- Introduction to Printing Technology – Hugh M Speirs, Taylor & Francis Books Ltd.
- Handbook of Print and Production – Micheal Barnard, John Peacock, Chapman & Hall
- Printing Materials Science & Technology Vol. 24, J. Anthony Bristow.
- Type setting – Composition – Geoff, Barlow, Chapman & Hall
- Hand book of Type graphy – Kailas Tahle.

Detailed Syllabus		Weightage
Unit 1: Kinematic pairs, Kinematic chains and degree of freedom of mechanism. Combined kinematic chains. Inversions of mechanism and their applications. Introduction to cam design and its applications.	10	10%
Unit 2: Motion Characteristics of slider crank mechanism. Velocity and acceleration analysis of mechanisms with single degree of freedom system using graphical method. Instantaneous centre, Kennedy's theorem, analysis of velocities of mechanism using instantaneous centre method. Analytical technique applied to only slider crank mechanism, Denavit-Hartenberg and Kutzbach's classification.	10	10%
Unit 3: Introduction, Classification of Followers, Classification of C.A.M., Definition Motion of the follower, Displacement velocity & Acceleration diagrams when the follower moves with uniform velocity. Displacement, velocity and acceleration diagrams when the follower moves with D.M. Displacement, velocity and acceleration diagrams when the follower moves with uniform acceleration and deceleration. Displacement, velocity and acceleration diagrams when follower moves with cycloidal motion.	10	10%

S.E (Printing & Packaging Technology)		Semester - IV	
Subject: Theory of Machines			
Periods per week 1 period of 60 min.	Lecture	4	
	Practical	2	
	Tutorial	--	
Evaluation System		Hours	Marks
	Theory Examination	3	100
	Practical	--	--
	Oral Examination	--	--
	Term Work	--	25

Detailed Syllabus

Unit - I	Basic concepts	Periods	Weightage
	Links, kinematic pairs, kinematic pairs giving one, two and three degrees of freedom, kinematic chains, degrees of freedom and movability criterion. Constrained kinematic chains as mechanism. Inversions of single and double slider crank chains and their applications. Introduction to pantograph, straight line motion mechanism,	06	10%
Unit - II	Motion Characteristics Of Mechanisms Velocity and acceleration analysis of mechanisms with single degree of freedom system using graphical method, Instantaneous centre, Kennedy's theorem, analysis of velocities of mechanism using instantaneous centre method. Analytical technique applied to only slider crank mechanism, Bennett's construction and Ritterhau's construction.	10	17%
Unit -III	CAMS Introduction, Classification of Followers, Classification of CAMS, Definition Motion of the follower, Displacement velocity & Acceleration diagrams when the follower moves with uniform velocity. Displacement, velocity and acceleration diagrams when the follower moves with SHM Displacement, velocity and acceleration diagrams when the follower moves with uniform acceleration and retardation. Displacement, velocity and acceleration diagrams when follower, moves with cycloidal motion, construction of CAM profiles.	10	17%

Detailed Syllabus		Periods	Weightage
Unit - IV	Clutches, Brakes and Dynamometers Study and analysis of single plate clutch, multiple plates clutches and cone clutches. Introduction, types of brakes, viz. block and shoe brakes, band brake, band and block brakes, braking of vehicles. Types of dynamometers, viz. Prony brake, Rope brake, belt transmission dynamometers	08	14%
Unit - V	Flywheel Turning moment diagram, fluctuation in energy, function of flywheel, estimating inertia of flywheel for reciprocating prime moves and machines, Static force analysis in gears - spur, bevel, helical, worm and worm gear, Static and dynamic force analysis - in linkage mechanism (up to 4 links) by virtual work method.	08	14%
Unit - VI	Gear Trains: Kinematics and dynamic analysis of - simple gear trains, compound gear trains, reverted gear trains, epicyclic gear trains with spur or bevel gear combination.	07	14%
Unit VII	Belt and Rope Drive Types - flat, V, rope belt, Kinematic Analysis- velocity ratio, slip and creep of belt length of belt for open and crossed belting dynamic analysis - driving tensions, centrifugal tension, initial tension, Power transmission, max power transmission condition.	07	14%

Term Work:

Each student has to appear for at least one written test during the term. Report on Laboratory Study Experiments along with a graded answer paper shall be submitted as term work.

The distribution of term work will be as follows:

Report on study experiments and assignments- 15 marks

Written test - 10 marks

Laboratory study Experiments

- Study of links, kinematic pairs, kinematic pairs, Inversions of single and double slider crank chains, pantograph, straight line motion mechanism using models.
- Construction of CAM profile
- Study of clutches and brakes
- Study of power transmission system in automobile

Assignments: Minimum three problems on each topic of the syllabus

Text Books

- Theory of Machines – Thomas Bevan – C.B.S Publishers, 1984
- Theory of Machines – S.S.Ratan – Tata McGraw Hill, 1995
- Theory of Machines – P.L.Ballaney, Khanna Publishers, Delhi
- Theory of Machines and Mechanisms – Joseph E. Shigley and John J. Uicker, Jr., McGraw Hill Int. edition, 1995
- Theory of Mechanisms and Machines – A.Ghosh and A.Malik – Affiliated East – West Press Pvt. Ltd., New Delhi

REFERENCE BOOKS

- A text book of Theory of Machines – W.G.Green – Bluckie & Sons Ltd.
- A text book of Theory of Machines – R.K.Bansal, Lakshmi Publications
- Mechanics & Dynamics of Machinery – J.Srinivas, Scitech

S.E (Printing & Packaging Technology)		Semester - IV	
Subject: Advanced Control Systems			
Periods per week Period of 60 min.	Lecture	3	
	Practical	2	
	Tutorial	--	
		Hours	Marks
Evaluation System	Theory Examination	3	100
	Practical	--	--
	Oral Examination	--	--
	Term Work	--	25

Detailed Syllabus

		Periods	Weightage
Unit - I	Design Specifications Relative stability, Steady state accuracy (error), Transient response, Frequency response characteristics	04	10%
Unit - II	Control configurations Series (Cascade) compensation, Feedback compensation, State feedback compensation, Series feedback compensation, Feed forward compensation	05	12%
Unit - III	Design via root locus techniques Transient response design via gain adjustment, improving steady error via Cascade compensation, Improving transient response via Cascade compensation Improving steady state and transient response, Feed back compensation	06	14%
Unit - IV	Design via frequency response Transient response via gain adjustment, Lag compensation, Lead compensation Lag-lead compensation	05	12%
Unit - V	Design via state space Advantages of state space, Analysis of the state equations, Control-law design for full-state feedback, Selection of pole locations for good design, Estimator design Compensator design: combined control law and estimator, Introduction to the reference input with the estimator, Integral control and robust tracking	06	14%
Unit - VI	Digital control Digitization, Dynamic analysis of discrete systems, Design by emulation, Discrete design, State space design methods	05	12%
Unit - VII	Hardware characteristics Analog to Digital (A/D) converters, Digital to Analog (D/A) converters, Anti - Alias prefilters, the computer.	04	10%

Detailed Syllabus

Unit -VIII	Word size effects Random effects, Systematics effects	Periods	Weightage
		03	6%
Unit - IX	Sample rate selection Tracking effectiveness, Disturbance rejection, effect of anti alias prefiliterers, Asynchronous sampling	04	10%

Term Work:

Each student has to appear for at least one written test during the term. Report Laboratory Experiments based on Computer Programmes/Simulations/Hardware along with a graded answer paper shall be submitted as term work.

The distribution of term work will be as follows:
Report on experiments – 15 marks
Written test – 10 marks

Text Books

- G.Franklin, J.D. Powell & Abbas Emami-Naeini: feedback control of dynamic systems, 2nd edition (LPE), Pearson Education asia
- J.Wilkie, M.Johnson & R.Katebi: control engineering: an introductory course, 1st edition, palgrave
- Norman S Nise: Control System engineering, 3rd edition, John wiley and sons, Inc
- B.Kuo & F.Golnaraghi: Automatic control systems, 8th edition, John Wiley and sons, Inc
- K.Ogata: Modern control Engineering, Prentice-Hall, 3rd edition, 1996,.