

BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, ORISSA

M.TECH IN PLASTICS ENGINEERING

FROM THE ACADEMIC SESSION: 2009-2010

FIRST SEMESTER			
Nature/ Parameter	No. of Subjects	Credits	Remarks
Professional core	3	12	4 Credit each
Elective	2	6	3 Credit each
Sessionals /Laboratory	1 or 2	4	
Pre-Thesis work and Seminar	---	2	
TOTAL		24	
SECOND SEMESTER			
Professional core	2	8	4 Credit each
Elective	3	9	3 Credit each
Sessionals /Laboratory	1 or 2	4	
Pre-Thesis work and Seminar	--	2	
Comprehensive Viva Voce-I	---	2	
TOTAL		25	
THIRD SEMESTER			
Thesis part-I	----	14	
Open Elective	----	3	
TOTAL		17	
FOURTH SEMESTER			
Thesis part-II	---	20	
Seminar	---	2	
Comprehensive Viva Voce-II	---	2	
TOTAL		24	
GRANT TOTAL		90	

Total credits: 90 (Break-up as per BPUT guidelines)

Subject Items	Credits
Professional Core	20
Professional Elective	18
Sessionals / Laboratory	8
Thesis / Project	34
Seminar	6
Comprehensive Viva-Voce	4
TOTAL	90

M.TECH IN PLASTICS ENGINEERING

Affiliated to Biju Patnaik University of Technology, Rourkela Approved by AICTE , New Delhi

FIRST SEMESTER

Course Code	Course Title	L	T	P	Credit
	1. Professional Core				
1	Polymeric Materials	3	1	0	4
2	Additives and Compounding	3	1	0	4
3	Plastics Processing Technology	3	1	0	4
	2. Elective				
1	Elective-I	3	1	0	3
2	Elective-II	3	1	0	3
	TOTAL	15	5	--	18
	3. Sessional / Laboratory				
1	Plastics Processing and Testing Laboratory	0	0	3	2
2	Plastics Product Design and Tooling, Software Laboratory Part-II	0	0	3	2
	TOTAL	0	0	6	4
	4. Pre-Thesis work and Seminar - I	0	0	4	2
	NET TOTAL	15	5	10	24

SECOND SEMESTER

Course Code	Course Title	L	T	P	Credit
	1. Professional Core				
1	Properties & Testing of Plastics	3	1	0	4
2	Plastics Processing Theory and Product Design.	3	1	0	4
	2. Elective				
1	Elective-III	3	1	0	3
2	Elective-IV	3	1	0	3
3	Elective-V	3	1	0	3
	TOTAL	15	5	--	17
	3. Sessional / Laboratory				
1	Plastics Product Design and Tooling, Software Laboratory Part-II	0	0	3	2
2	Plastics Processing and Testing Laboratory - II	0	0	3	2
	TOTAL	0	0	6	4
	4. Pre-Thesis work and Seminar - II	0	0	4	2
	5. Comprehensive Viva Voce	0	0	4	2
	NET TOTAL	15	5	14	25

THIRD SEMESTER

Course Code	Course Title	L	T	P	Credit
1	Thesis part-I	---	---	---	14
2	Open Elective	3	1	0	3
	TOTAL				17

FOURTH SEMESTER

Course Code	Course Title	L	T	P	Credit
1	Thesis part-II	---	---	---	20
2	Seminar	---	---	4	2
3	Comprehensive Viva Voce-II	---	---	---	2
	TOTAL				24

TOTAL CREDIT (24+25+17+24) = 90

ELECTIVE SUBJECTS (3-1-0) 3 Cr.

ELECTIVE – I

1. **Composites Materials**
2. Plastic Foams
3. Numerical methods in Plastics Processing
4. Plastics Packaging.

ELECTIVE - II

1. **Mathematics for plastics engineers**
2. Fundamentals of Plastic Mould & Die Designing
3. Safety and Pollution Control in Plastic & Polymer Industries.
4. Fibre Technology

ELECTIVE -III

1. **Polymer Blends and Alloys**
2. Coating Science & Technology
3. Bio-medical Plastics
4. Biodegradable Plastics

ELECTIVE –IV

1. **CAD/CAM/CAE application in mould/tool design**
2. Polymer degradation and stabilisation .
3. Plastics waste management and recycling.
4. Mechanical behaviour of polymers

ELECTIVE -V

1. **Production management .**
2. Nylon technology
3. Speciality elastomers
4. Strength of materials

OPEN ELECTIVE (3-1-0) 3 Cr.

1. **Quality Management**
2. Engineering Economic and costing
3. Human Resource Management
4. Marketing Management

THEORY

Professional core

1. POLYMERIC MATERIALS (3-1-0) 4 Cr.

1. Introduction to Polymeric Materials, Techniques of Polymerization, Molecular weight and its distribution, Molecular Architecture (Linear, Branched, Cross-linked) / Tacticity, Amorphous and Crystalline Polymers, Glass and Melting Transitions., Liquid Crystalline Polymers, Conducting polymers.
2. Sources and manufacturer of raw materials for polymers [C₁ – C₆].
3. Comparative properties and applications :
Thermoplastics : Polyolefin's (polyethylene's, polypropylene, vinyl polymers and copolymers, styrene-homo and copolymers, Acrylic homo and co-polymers, cellulose, nylons, aromatic polyamides and polyimides, PET, PBT and aromatic polyesters, fluoro polymers, polycarbonates, polyacetals, aromatic polyether/ polysulfones / polyphynelens / polyetheretherketone / polyurethanes / Thermoplastics / Thermosets).
4. Comparative properties and applications
Thermosetting plastics : Formaldehyde resins (PF/UF/MF), Epoxy resins, unsaturated polyesters, silicones.

TEXT BOOKS :

1. J.A.Brdyson, "Plastics Materials", Butterworth Heinemann, Oxford, 7th edition (1999).
2. Fred W.Billmeyer, Jr., "Text Book of Polymer Science", John Wiley and Sons, Singapore
3. P.Ghosh, "Polymer Science and Technology of Plastics and Rubbers – New Edition.

2. ADDITIVES AND COMPOUNDING (3-1-0) 4 Cr

1. Introduction to additives- Technological requirements, classification of additives, chemistry, function and mechanism, principles of mixing.
2. Fillers : Coupling agents, plasticizers and softeners, lubricants, flow promoters.
3. Antiageing additives : Antioxidants, antiozonants, stabilizers (UV/Thermal etc), UV absorbers, Flame retardants, coloring materials, blowing agents, cross-linking agents, toughening agents.
4. Mixing and compounding techniques : EQUIPMENTS : Batch mixers and continuous mixers, two / three roll mills, Intermix, ribbon blender, planetary mixer, single screw and multiple screw mixer, extruders.
Principles and operating details of the above mentioned equipments.

Text Books :

1. R.Gachter and H. Muller, "Plastics Additives Hand Books", Hanser Publications, Munich (1993).
2. J.A. Brydson, "Plastics Materials" Buterworth – Heinmann, Oxford (1999).
3. J.Murphy, "The additives for Plastics Hand Book", Elsevier, Oxdford (1996).

3. PLASTICS PROCESSING TECHNOLOGY (3-1-0) 4 Cr

1. Extrusion : Introduction and Principles – Single screw, specifications, types of screw (single/twin, extruder parts and their functions); products defects, causes and remedies. Extrusion blow molding and stretch blow molding-process sequences, the machine, multiple cavity blow molding, co-extrusion, preform production, comparison between blow and stretch blow molding.
2. Injection : Introduction and principles, components-functions, process variables, product defects and remedies. Injection blow moulding, Thermoplastics and thermosetting comparative behaviors.
3. Compression and transfer moldings : Introduction and principles, machine process and process variable, product defects and remedies, comparison between the above – mentioned process.
4. Rotational molding and thermoforming process : Principle and practices.

TEXT BOOKS :

1. D.H.Marion-Jones, “Polymer Processing”, Chapman and Hall, London(1989) or newer edition.
2. W.Michaeli, “Plastics Processing – An Introduction” Hanser Publishers, New York (1992).
3. Seymour S.Schwartz and Sidney H.Goodman, ‘Plastics Materials and Process, Van Nostrand Reinhold Co., New York (1982).

ELECTIVE SUBJECTS

ELECTIVE – I (Any one of the following subjects)

1. COMPOSITE MATERIALS (3-1-0) 3 Cr.

1. Composite materials for structural applications, Manufacturing methods of FRP composites, polymers and ceramics.
2. Fibrous and particulate composites, Micromechanical and Macromechanical behavior of orthotropic laminate and laminated composites.
3. Evaluation of strength and failure criteria of composites, Optimum fiber reinforcement criteria, Kelly-Davies model.
4. Testing, joining, environmental effects and the effects of defects on performance of composites, interpenetrating network.

TEXT BOOKS :

1. Lawrence E.Nielsen and Robert F. Landel, “Mechanical Properties of Polymers and Composites”, 2nd Edition, Marcel Dekker, New York (1994).
2. B.T.Astrom, “Manufacturing of Polymer Composites”, Chapman and Hall, London (1995).
3. T.G.Gutowski, “Advanced Composites Manufacturing:”, John Wiley and Sons, New York (1997).
4. Jones, R.M. “Mechanics of Composites Materials” Scripta Book Co.

2. PLASTICS FOAMS : (3-1-0) 3 Cr.

1. Introduction to foams, type of foams (open and closed cell) and its applications, Manufacturing process, formulation and compounding of foams.
2. Rigid and flexible foams – stiffness and strength.
3. Characterization, testing and properties of foams with special reference to fatigue, shock absorption, acoustical behavior morphology etc.
4. Reinforcement of foams : Low and High-density foams and the reinforcing materials and methods.

TEXT BOOKS :

1. N.C.Hilyard, "Mechanics of Cellular Plastics", Applied Science Publishers, London (1982).
2. John Brydson, "Plastics Materials", 7th edition, Butterworth – Heinman, London (1999).

3. NUMERICAL METHODS IN PLASTICS PROCESSING : (3-1-0) 3 Cr.

Use of numerical methods in the solutions of problems concerning rheology, heat transfer, diffusion and viscoelastic theory.

Topics to include :

1. (a) Ordinary differential equation
(b) Simultaneous linear equations
2. (a) Finite difference methods
(b) Interactive solution methods.
3. (a) Regression analysis
(b) Interactive solution methods.
4. (a) Linear and quadratic interpolations
(b) Curve fitting Techniques.

TEXT BOOKS

1. Kreyszig : Advance Engineering Mathematics
2. Salvadori and Mc Carmik : Numerical Methods
3. C.S.Desai and J.F.Abel : Introduction to finite element method.

4. PLASTICS PACKAGING (3-1-0) 3 Cr.

1. Introduction and basis principles, Rigid and flexible packaging for food, beverages, cosmetics, pharmaceuticals, health care products electronics materials, Chemicals, equipments and machinery.
2. Flexible packaging : Manufacturing process, product evaluation, testing and applications.
3. Films for packaging materials and process, Bubble films, shrink films, plastics paper, multilayer films and laminates, cross linked films.
4. Sterilization of plastics – Dry heating, Radiation sterilization Chemicals sterilization, Supercritical carbon dioxide.

TEXT BOOKS

1. A.S.Athalye, "Plastics in Packaging", Tata McGraw – Hill Publishing Co. Ltd., New Delhi (1992).
2. A.S.Athalye, "Plastics in Flexible Packaging", Multi Tech Publishing Co. Bombay (1992).

ELECTIVE – II (Any one of the following subjects)

1. MATHEMATICS FOR PLASTICS ENGINEERS (3-1-0) 3 Cr.

1. Partial differential equations : Linear and quasilinear first order partial differential equations, second order linear equations in two variables and their classifications, Cauchy, Dirichlet and Newman problems, Green functions; Solutions of Laplace, wave and diffusion equations in two variable and application to physical problems.
2. Vector and tensor analysis, Matrices and Determinants, Vector differential calculus, Laplace and Fourier transforms. Introduction to numeric use of the above techniques in plastics engineering and calculations.
3. Probability : Random experiment, event space, classical and statistical definition of probability, conditional probability, probability distribution (both one and two dimensions). Distribution Functions : Binomial, Normal Poisson, Uniform, Cauchy and Gamma, Mathematical Expectation, Mean , Variance, Moment dispersion, Kurtosis, Median, Mode , Least square method of curve fitting, Regression Analysis, correlation co-efficient.
4. Statistics : Sampling theory, populations, sampling errors and bias, sampling methods : random, sampling distribution. Estimation and testing of hypothesis – theory of estimation, point estimates, consistent and unbiased estimates. Methods of point estimation – method of maximum likelihood, interval estimation, Null hypothesis, critical region.

TEXT BOOKS

1. Kreyszig, “Advanced Engineering Mathematics”.
2. **FUNDAMENTALS OF PLASTICS MOULD / DIE DESIGN (3-1-0) 3 Cr.**

Unit 1 Mould Design

Orthographic projection-Projection of solids—vertical and horizontal surfaces-Inclined Surfaces-Curved Surfaces-Sectional views and assembly drawing.

Unit 2 Product Design

Basic Principles-Shrinkage-Flash lines-Undercuts-suggested Wall thickness-Draft-Tolerance-Moulded holes-threads-radius- moulded hinges-integral hinge-snap fits - product design thumb rules - case studies and product design.

Unit 3

Parting line-Construction of core and cavity-types of gate-types of ejection-Mould temperature control - cooling - Mould alignment Mould ancillary parts.

Unit 4

Types of moulds-two plate - three plate - split moulds - Machine selection-Principles of shrinkage allowances-materials for mould parts-life of mould-mould maintenance-case studies on mould design.

Unit 5 Screw Design

Extrusion -- extruder parts - extrusion screw - design features - design variables.

Injection Moulds for threaded components – automatic unscrewing – various unscrewing methods

Total Lectures = 45

Tutorial = 15

Text Books

1. Injection Mould Design for Thermoplastic - By Pye, R.G.W
2. Injection Mould & Molding - By Dym
3. Injection Moulds – 130 Proven Design - By Gastrow, H
4. Plastics Product Design Engineering Hand Book - By Dubois, H
5. Plastics Product Design & Process Engineering - By Belofsky, Harold

Reference Books

1. Plastic Design & Processing - By Sharma, S.C
 2. Plastics Moulds & Dies - By Sors, & Others
 3. Injection Mould Design Fundamentals (Vol. I& II) - By Glanvill & Denton
- Injection Mould -By VDI

3. SAFETY & POLLUTION CONTROL IN PLASTICS AND POLYMER INDUSTRIES (3-1-0) 3

Cr.

- Unit – I : Safety and Health at work, Managing safety, Safety Policy, Identification & evaluation of risks. Safety inspection – Checklist, documentation, Managers participation in safety, MIS.
- Unit – II : Environmental Engineering, Noise in Industry & its effect on Human being, effective methods of noise reduction, lighting for working, Heat stress in Plastics Industries & effects of over exposure to heat, combating heat stress industry. Industrial ventilations & Exhaust systems.
- Unit – III : Chemical Safety Management if Hazardous / toxic materials occupational health management, the human side of safety employees participation in safety accident prevention programme.
- Unit – IV : Earth & its environment, business enterprise, environmental issues related to the Plastics Industries – Global concern V/s Local & regional concerns, Global warming, depletion of stratospheric ozone. Polymer & Energy, Plastics in the Marine Environment. Environmental effects on polymeric materials.

Text Books

1. Safety Management in Industry : N.V.Krishnan, Jaico Publishing House, 1997.
2. Plastics and the Environment Anthony L. Andraday, John Willy & Sons 2003.
3. Mc Grawhills Hazardss Chemicals safety guide for the plastics industry.
4. Plastics for Environment & Sustainable Development ICPE & CIPET Publication 2003 Ed.

4. FIBRE TECHNOLOGY (3-1-0) 3 Cr.

UNIT-1

Introduction to natural and synthetic polymers. Essential characteristics and molecular architecture of fibre forming polymers.

UNIT-2

Concept of order in polymers, crystallinity, orientation, physical structure of natural and man-made fibers.

UNIT-3

Physical methods for investigating fiber structure. Optical properties of oriented polymers and fibres, refractive index and birefringence.

UNIT-4

Melt spinning, dry and wet spinning of fibers. Fiber drawing, heat setting, texturing and mechanical properties of fibers based on viscose, cellulose acetate, polyamides.

UNIT-5

Fiber drawing, heat setting, texturing and mechanical properties of fibers based on polyesters, acrylics, polypropylene, glass and carbon-fibres. General principles of finishing and dyeing of fibers. Common types of finishes applied to textile fibers.

Reference Books

1. Billmeyer Jr.; Fred W., Synthetic Polymers, Doubleday and Co. Inc., New York (1972).
2. Gupta, V.B., and Kothari, V.K., Manufactured Fibre Technology, Chapman & Hall, 1997.
3. Fourné, Franz, "Synthetic Fibres, Machines and Equipment, Manufacture, Properties", Hanser Publishes, 1999.

Corbman, Bernard P, "Textiles fibre to fabric", Sixth Edition, McGraw Hill, 1983

SESSIONAL / LABORATORY

1. PLASTIC PROCESSING AND TESTING LABORATORY-I (0-0-3) 2 Cr

1. Plastic Processing Lab (25 Hrs)
 1. Injection Moulding (Hand Operated)
 2. Injection Moulding (Semi-Automatic)
 3. Injection Moulding (Automatic)
 4. Extrusion Process
 5. Compression Moulding (Hand Operated)
 6. Compression Moulding (Semi Automatic)
 7. Blow Moulding (Hand Operated)
 8. Scrap Grinding.

2. PLASTICS TESTING LAB (20 Hrs)

1. Chemical Lab : Identification of Plastics – Viscosity and Molecular Weight Determination – Determination of K.Value for PVC.
2. Demonstration : Melting point – Carbon black content – Filler content –Environmental stress cracking resistance – PH meter – Hopper viscometer – Brookfield Viscometer.
3. Specimen preparation Lab : Specimen preparation using injection moulding machine – compression moulding machine – two roll mill and contour cutter.
4. Demonstration : Scrap grinder – Blender.
5. Physico-Mechanical Lab : Tensile strength – Flexural strength – compression strength – Tear strength – Impact strength – Hardness.
6. Demonstration : Abrasion resistant tester – Folding endurance tester – Burst strength tester – Density gradient column – Creep tester – Moisture vapour transmission rate – gas permeability – Sieve analysis.

II . PLASTICS PRODUCT DESIGN AND TOOLING SOFTWARE LABORATORY

Part – I (0-03) 2 Cr.

1. Basic Engineering Software.
2. Part drawing from product.
3. Design of mould elements.
4. Two plate mould design (Injection) single impression.

PRE-THESIS WORK AND SEMINAR (2 Cr.)

SECOND SEMESTER

PROFESSIONAL CORE

1. PROPERTIES AND TESTING OF PLASTICS (3-1-0) 4 Cr.

UNIT – 1 : Concepts of Testing & Identification Of Plastics

Basic concepts of testing-Specification and Standards – National and International Standards – Test specimen preparation – Pre-conditioning and test atmosphere.

Identification of plastics by simple test : Visual examination – Density – Melting point – Solubility test – Flame test – Chemical tests.

UNIT – II : Physical Testing

Long –term Mechanical Properties : Creep – Stress relaxation.

Short-term Mechanical Properties : Tensile properties – Flexural properties – Compressive properties – Shear properties – Impact properties – Tear resistance – Hardness tests – abrasion resistance – Friction test.

Gas and Moisture Permeability – Environmental stress cracking resistance – Cracking.

Dielectric Strength – Dielectric Constant and dissipation factor – insulation resistance – volume and surface resistivity – Arc resistance – Antistatic tests.

Refractive index – Luminous transmittance – Clarity and Haze – Photo –elastic properties – colour measurements and Specular Gloss.

UNIT – III : Thermal Properties

Melt flow index : Heat deflection temperature – Vicat softening temperature – Marten's Heat resistance test – Brittleness temperature – Specific Heat – Glass transition temperature – thermal conductivity – Co-efficient of thermal expansion – Shrinkage – Thermal stability – Flammability.

UNIT – IV : Permanence Properties and Product Testing

Water absorption : Chemical Resistance – UV resistance – Ozone resistance – weathering resistance – salt spray and straining resistance – Irradiation effects – Microbiological attack.

Testing of pipes and fittings – films and sheets – container – Foam – Laminates and FRP based products – Failure Analysis.

Text Book

1. Vishu Shah, Hand Book of Plastics Testing Technology, John Wiley & Sons Inc. New York
2. R.P.Brown, Hand Book of Plastics Test Methods, George Godwin Ltd., London, 1981.
3. Analysis & Testing by Crompton.
4. J.S.Anand, K.Ramamurthy, K.Palanivelu how to identify Plastics by Simple Methods.

5. G.C.Lves, J.A.Mead, M.M.Riley, Hand Book of Plastics Test Methods, The Plastics Institute,
6. Frank T.Traceski, Specifications & Standards for Plastics & Composites, ASM International, Metals Park, OH, 1990.
7. J.Hasiam, H.A. Willis, Identification & Analysis of Plastics, London Iliffe Books Ltd., New Jersey,

2. PLASTICS PROCESSING THEORY AND PRODUCT DESIGN (3-1-0) 4 Cr.

1. Injection Moulding : Introduction to microprocessor control systems, effect of processing parameters on moulding quality, frozen in stresses, Annealing, Processing of Engineering Plastics, Statistically process control.
2. Fabrication & decoration of plastics – Sealing, Welding, Joining, Printing, Painting, Host Stamping, Vacuum metalizing, In mould decoration.
3. Calendaring : Introduction, type of calendars, roll, configuration, definition of terms such as calendar bank, calendaring process, process variable and application.
4. Concepts : Size, shape and function – form and function – Aesthetics, Ergonomics – Shrinkage, Flash lines, Undercuts – External & Internal – wall thickness – variance in wall thickness – suggested wall thickness for thermoplastics and thermosetting materials – steps in product design – emphasize on designing with engineering plastics – Taper or draft – Fits & Tolerance – Designing with plastics for load bearing applications like gear, bearing etc. Design of radii, fillets, ribs & bosses – Design for flow and shape – moulded holes – through hole – blind holes – threaded holes – side holes – holes parallel to draw – nearness of holes of each other and side wall – moulding holes not parallel to draw – drilled and tapped holes – moulded threads – moulded lettering – surface treatment.

Text Books

1. Donald V. Rossato, Injection Moulding Hanbook, International Thomson Publishing Co., 1995.
2. M.S.Welling, Injection Moulding Technology, VDI – Verlag Gmbh, 1981.
3. Seymour S.Sctiwartz & Sidney H.Goodman, Plastics Materials and process, Van Nostrand Reinhold Company, New York, 1982.
4. RGW PYE Injection Mould Design for Thermoplastics, affiliated East-West Press P. Ltd., New Delhi 1989.
5. Beck, Plastics product design, Yan Nostrand Reinhold Company London.
6. Donatas satas Plastics Finishing and Decoration Van Nostrand Reinhold Company, New York. 1986.
7. James M. Margoills, decorating Plastics, Hanset Publishers, New York, 1986.

ELECTIVE SUBJECTS

Elective – III (Any one of the following)

1. POLYMER BLENDS AND ALLOYS (3-1-0) 3 Cr.

1. Definition, classification and importance of polymer blends and alloys, copolymer vs. polyblends and alloys; concept of polymer miscibility, thermodynamics of polyblends.

2. Interchain forces in polyblends, interpenetrating polymer network in polyblends, morphology and phase separation.
3. Preparation, processing and properties, characterization techniques rheology of polyblends and alloys.
4. Applications of polyblends and alloys in adhesive, molded products, footwear, films, fibers, surface coating, miscellaneous uses, current trends in polyblends and alloys technology.

Text Books :

1. Polymer Blends & Alloys – An Overview,,: RP Singh, CK Das, S.K.Mustafi, Asian Books Published 1st ed. 2002.
2. Polymer Blends & Alloys: Folkes & Hopes Blackie academic Professional 1993.
3. Advance in Polymer Blends & Alloys Technology by Malvyn Kohudic, Technomic, 1988.
4. L.A. Utracki, Commercial Polymer Blends, Chapman & Hall, London, 1998.
5. D.R.Paul & Seymour Newman, Polymer Blends, Vo. 1 & 2, Academic Press, New York, 1978.
6. Chris Rauwendaal, Polymer Mixing a self study guide, Hanser Publishers, Munich, 1998.

2. COATINGS SCIENCE & TECHNOLOGY (3-1-0) 3 Cr.

1. Basic paint technology ; Polymer binders, Pigments and extenders, additives.
2. Essential concepts of paint formulation and paint properties : pain preparation (pigment dispersion), surface preparation and paint application, paint properties and their evaluation, mechanism of film formation, factors affecting coating properties, methods used for film preparation and their properties; barrier properties and corrosion, mechanical properties, aging properties, rheological properties, adhesion properties and other related properties.
3. Mathematics of paint formulation, formulations of coating as finishes (automotive, appliance, coil, can, marine, aircraft etc.)
4. State of the art technologies, specialty coating (radiation durable, nonpolluting, powder, high solids etc.)

TEXT BOOKS

1. Outline of paint technology, W.M. Morgans (3rd Edition – Recently CBS Publishers.
2. Paints, Coatings and Solvents, Dieter Stage (ED.) – 2nd Edition – Wernon Freitag Ltd., (Eds).
3. Principle & Paint Formulation, R. Woodbroidge (Ed.) – 1991.

3. BIO-MEDICAL PLASTICS (3-1-0) 3 Cr.

1. Synthetic and Natural biomaterials used in Biomedical applications
 - i) Polyolefin's, Polyamides, Acrylic Polymers, Fluorocarbons, Polyesters, Engg. Plastics.
 - ii) Collagen, Polysaccharides, Proteins etc.
2. Human applications of Plastics : Cardiovascular implants, Dental Implants, Role of plastics in Ophthalmology, Hydro gels, Drug Delivery Systems, Sutures, Burn Dressings and Artificial Skin. Hernia Mesh, adhesives and Sealants, Artificial organs and devices, Blood bags, Condoms etc.

3. Blood – polymer interactions and blood compatibility, Chemical and biochemical degradation of polymers, Tissue engineering and polymers.
4. Testing and evaluation: in-vitro-/vivo; Standards in product development and regulations; Ethical and sociological issues.

Books

1. Buddy D. Ratner, Allan S. Hoffman, Fredrick J.Schoen and Jack E. Lemons (eds), “Biomaterials Science – An Introduction to Materials in Medicine”, Academic Press, San Diego (1996).
2. Joon B. Park and Roderic S. Lakes, “Biomaterials : An Introduction”. 2 edition, Plenum Press, New York (1992).
3. Sujata V. Bhat, “Biomaterials”, Narosa Publishing House, New Delhi, (2002).

4. BIODEGRADABLE PLASTICS (3-1-0) 3 Cr.

1. Plastics & Environment, Degradation, Bio-degradation of Plastics.
2. Renewable resources, synthetic & natural plastics, Biodegradable starch based polymers, Microbial Polyamino acid, Lignum, Aliginate based cellulose / PLA / PHA Polyester, Polysaccharides, Chitens & chitosan etc.
3. Emerging applications areas: Coated Papers, Agricultural Mulch Film, Shopping Bags, Food Waste Film and Bags, Consumer Packing Materials, Landfill Cover Film, Other applications.
4. Disposal Environments & Plastics Sorting and Reprocessing
Composing facilities and soil Burial, Anaerobic Digestion, Waste Water Treatment Plant, Reprocessing Facilities, Landfills, Marine and Freshwater Environments, Litter, Key Issues, Recyclable Plastics Sorting considerations, Reprocessing Considerations.

Text Books

1. G.J.L. Griffin, Chemistry and Technology of Biodegradable Polymers, Blackie Academic Professional, 1994.
2. Gerald Scott & Dan Gilad, Degradable Polymer – Principles & Applications, Chapman & Hall,
3. Y.DoI and K.Fukuda (Eds), Biodegradable Plastics and Polymers, Elsevier (1994)
4. Absorbabale & Biodegradable Polymers – S.N.Shalaby & K.J.L. Burg, CRC Press (2003).

ELECTIVE-IV (Select any one of the following subjects)

1. CAD/CAM/CAE APPLICATION IN MOULD/TOOL DESIGN (3-1-0) 3 Cr.

1. Introduction – Basic Concepts of computer aided design – CAD and CADD system – shape and size description. Parametric programming – Construction of Engineering drawing – Two dimensional drafting – 3D surface and solid modeling – concepts of engineering data base-various techniques used to analyse the material properties.
2. Introduction to numerical control system – CNC machines – Types of control system for CNC machine – CNC processing – co-ordinate system – CNC axis and motion-CNC milling – CNC turning – CNC EDM – machining – CNC wire EDM concepts – concepts of CNC

programme – tool motion – canned cycles – CNC interface with CAD-CNC stimulation software.

3. Computer integrated manufacturing (CIM) – computer aided design & manufacturing CAD/CAM process – advanced CAD/CAM Technology – Flexible Manufacturing System (FMS).

Rapid prototyping – processor – Applications – Reverse Engineering - New generation cutting tools for mould manufacturing.

4. Computer Aided Engineering (CAE) – Finite Element Analysis (FEA) – Flow analysis – Thermal analysis – Warpage Analysis – Cooling Analysis – Shrinkage Analysis – Pressure Analysis – C Mould – Mould Flow Analysis – Introduction and Application.

Text Book:

1. Frank Nanfara, Tony Uccello, Derek Murphy, “The CNC Work Book” on Introduction to Computer Numerical Control, Addison, Wesley Publishing Company, USA, 1995.
2. Ibrahim Zeid, CAD/CAM – Theory & Practice, Mc. Graw Hill, International Edition, 1998.

2. MECHANICAL BEHAVIOUR OF POLYMERS (3-1-0) 3 Cr.

1. Elastic, viscoelastic and flow behavior of polymers, theory of linear viscoelasticity.
2. Creep and stress relaxations in polymers, super position principle and time-temperature equivalence.
3. Stress – strain behavior of polymers and the dependence of stress – strain curve on internal and external factors, plastic behavior of polymers, concept of forced elasticity and zarkov relation, fatigue and life time of polymers, fracture of polymers.
4. Thermo mechanical behavior and analysis.

Text Books :

1. Compositional & Failure Analysis of Polymers John Scheoirs, John Willey & Sons Ltd.- 2000.
2. Mechanical Properties of Polymers & Composites by Nielson & Landel 2nd edition, Marcel Dekker Inc. 1994.

3. PLASTICS WASTE MANAGEMENT AND RECYCLING (3-1-0) 3 Cr.

1. Plastics Waste: Definition of plastics waste and the associated problems, Identification, collection methods and separation. Integrated waste management – source reduction, recycling, energy recovering process through thermal and biological destruction, Land filling and composting.
2. Recycling of plastics: Recycling and sustainability correlation, Basic principles and recovery, recycling and resource conservation. Recycling Technology.
3. Waste recycling and pollution control.
4. Environmental issues, policies and legislation in India.

Text Book

1. R.J.Ehrig (Ed.), “Plastics Recycling – Products and Processes” Hanser Publication, Munich
2. Anthony L. Andrady (Ed.), “ Plastics and the Environment:, Wiley Interscience, New York
3. Ministry Of Environments - Publications

4. R.J.Brandrup, "Recycling and recovery of Plastics", Hanser Publications, Munich (1996).
5. N.Mustafa, "Plastics Waste Managements, Disposal Recycling and Reuse, marcel Dekker, New York (1993).

4. POLYMER DEGRADATION AND STABILISATION (3-1-0) 3 Cr.

Unit I

Introduction and Thermal Degradation: Definition - Modes of Polymer Degradation -Mechanistic Aspects - Single Step Process and Chain Reactions - Auto Oxidation - Random and Specific Site Attack - Thermal Degradation: Introduction - Methods for Evaluation of Heat Resistance (DTA, DSC, TGA, TMA) - Mechanistic Aspects - Heat Resistance Polymers -Ablation –Stabilization – Thermal Degradation and Recycling – Heat Effect in Bio Polymers.

Unit II

Mechanical Degradation and Ultrasonic Degradation: Introduction - Mechanistic Aspects - Degradation Studies - Polymer Degradation in Solution. Ultrasonic Degradation - Importance - Experimental Methods - Mechanism of Ultrasonic Degradation (Cavitations and Direct Effects) - Degradation Studies (Detection of Transient Species and Molecular Weight Distribution) Application of Mechanical Degradation: Stress - Induced Chemical Alterations of Polymers- Mastication of Natural and Synthetic Rubber - Mechano Chemical Synthesis of Block and Craft Copolymers.

Unit III

Photo degradation: Introduction - Mechanistic Aspects (Excited States, Free Radicals and Ionic Species, Energy Transfer and Energy Migration) - Degradation in the Absence of Oxygen (Norrish Types I & II Reactions) - Photo Oxidation (Auto Oxidative Process, Sensitized Degradation) - Stabilization - Application: Polymers with Predictable Life Time, Photo resists.

Unit IV

Degradation By High Energy Radiation and Biodegradation: Introduction - Aspects of Radiation - Mechanistic Aspects - Simultaneous Cross Linking and Degradation - Radiation Stability and Protection Radiation Effects in the Bio Polymers - Application: Lithography, X - Modes of Biological Degradation - Enzymatic Degradation in Bio Polymers (Polysaccharides, Proteins, Malice Acids) - Microbial Degradation of Synthetic Polymers -General Applications of Bio Degradable Plastics - Examples of Biodegradable Polyesters and Polyamides.

Unit V

Chemical Degradation: Introduction - Solvolysis - Polymer Characterization by Solvolysis -Stability of Polymer Against Solvolytic Agents - Commercial Applications - Ozonisation -Oxidative Degradation - Auto Oxidation of Polymers. Ionic Degradation: Alkaline Degradation of Poly Saccharides Acidic Degradation of Polyaldehydes and Polyacetals and Cationic Degradation of Polypropylene Sulphide and Polyesters.

Reference Books:

- 1 . W. Schnabel, Polymer Degradation - Principles and Practical Applications Hanser Publishers, New York, 1992.
2. Ann - Christine Albertsson , Samuel J. Huang , "Degradative Polymers Recycling and Plastic Waste Management" Marcel Dekker, New York, 1995.

3. Reich; Leo and Stivala; Salvatores, Elements of Polymer Degradation, McGraw-Hill Book Co., New York (1971).
4. Scott; Gerald and Gilead; Dan (Eds.), Degradable Polymers: Principles and Applications, Chapman and Hall, London (1995).
5. Bastioli, Catia (Ed.), Handbook of Biodegradable Polymers, Rapra Technology Ltd., Shawbury (2006).

ELECTIVE-V (Answer any one of the following)

1. PRODUCTION MANAGEMENT (3-1-0) 3 Cr.

Module – I (12 Hours)

1. Productivity : Importance, Productivity ratio, Productivity measurement, Productivity Index, awareness – Improvement – maintenance (A.I.M) process.
2. Production system : Models of production system, product Vs. Services, Process – focused & product focused systems, product strategies, product life cycle and production functions.
3. Forecasting : Methods – Moving average, exponential smoothing, regression analysis, coefficient of co-relation, Delphi, Market Survey.

Module – II (12 Hours)

4. Facilities Planning : Site location, facilities layout, workplace design, working conditions – noise, illumination.
5. Inventory Management EOQ models, safety stock and re-order level decisions, Distribution requirement planning, spare parts inventory control.

Module – III (10 Hours)

6. Motion study : Principles – economy, Time study – standard time.

Module – IV (12 Hours)

7. Production Planning & Control : aggregate planning, sequencing, Line balancing, Flow control, Dispatching, expediting, Gantt Chart, Line of balance, learning curve.

Text Books :

1. Riggs, J.L. Production Systems : Planning, Analysis & control John Wiley & Sons.
2. Buffa, E.S. & Sarin R.K. Modern Production / Operation Management, John Willey & Sons.
3. Chary, S.N. Production & Operations Management (TMH)
4. Muhelemann, Oakland & Lockyer, Production Operations Management, Macmillan.

2. NYLON TECHNOLOGY (3-1-0)

Unit I

History -Development and commercial Nylons Polyamidation-Principle of Polyamidation-Process Technologies-hydrolytic polymerisation-Ionic Polymerisation, Solid phase polymerisation and other polymerisation techniques. Chemistry-Polymerisation and equilibria, Kinetic molecular mass, deformation of chemical attack.

Unit II

Physical structure: Structure properties relationship-crystallizing, melting temperature, to solubility, molecular weight, melt viscosity, degradation and stabilization, Electrical and mechanical

properties. Characterisation: Identification, composition/moisture analysis, separation techniques, BGGmolecular mass and distribution, IR, NMR and X-ray diffraction.

Unit III

Fundamentals of Melt Processing: Measurements of viscosity, PVT relationships, importance of moisture, effect of molecular mass, shear, temperature, additives and channel shape. Applications of Rheological data to flow situation.

Processing techniques of melt processing: Processing reagents, material handling and drying, injection moulding, extrusion, blow moulding and monomer processing. Other processing Techniques: Powder coating, blending and solution coatings. Secondary Treatments: Assembly, Moisture conditioning, mechanical surface clearing, and decorating.

Unit IV

Modification: Physical change- co-polymerisation-transparent nylons, filled and reinforced nylons, toughened nylons, fire retardant nylons, plasticized and lubricated nylons, additives for heat stabilization, processing and color and other modifications.

Polymer Blends Alloys And Composites: Properties-factors affecting the properties of nylons, mechanical, thermal electrical and optical properties, moisture absorption, dimensional stability and density, environmental resistances and impact, flammability and failure analysis.

Unit V

Commercial Nylon Blends And Their Applications: PA6, PA66, PA46, PA6/2, PA11 & PA12

Raw materials- preparation –polymerisation- Methods of manufacturing, modifications, processing (methods, procedure processing parameters etc.,)

Properties (material, tribological durability, water absorption dimension stability (immersion resistance, thermal/ electrical/optical properties, flammability resistance to permeation

Applications)

Reference Books:

- iii) Malvin I. Kohan (ed.) Nylon plastics hand book, Hanser publisher, 1995.
- iv) Nicholar P. Chermisinof (ed.) Hand book of engineering Polymeric materials Marcel Dekker inc.N.Y. 19

3. SPECIALITY ELASTOMERS (3-1-0) 3 Cr.

Unit I

Introduction of speciality Rubbers – Silicones (Q) – Introduction, Manufacture – Structure and its influence on properties – Compounding – Fabrication – Curing – General properties – Applications – Copolymers – PMQ, PVLQ, FMQ, FVMQ – Silicones Rubber for medical use.

Unit II

Chlorosulphonated polyethylene – Introduction – Manufacture – Structure and its influence on properties – Compounding – Curing – Properties – Applications.

Epichlorohydrin – (CO, ECO, ETIR) – Introduction – Manufacture – Structure and its influence on properties – Compounding and Curing Properties and application.

Fluoro Elastomers (FKM) – Introduction – Manufacture – Structure and its influence on properties – Compounding – Curing – Properties and applications.

Unit III

Polysulphides (TM) - Introduction, Manufacture – Cross linked Polyethylene (XLPE) – Polyurethane Rubbers – Introduction Manufacture – Structure and its influence on properties – Compounding – Curing – Properties and applications. Thermoplastic Polyurethanes – Introduction – Manufacture – Structure and its influence on Properties – Compounding – Curing – Properties and applications.

Unit IV

Acrylic Rubber (ACM), Ethylene acrylic copolymers, Introduction, Manufacture – Structure and its influence on Properties – Compounding – Curing – Properties and applications. Ethylene Vinyl Acetate – Copolymer – Introduction, Manufacture – Structure and its influence on Properties – Compounding – Curing – Properties and applications

Unit V

Chlorinated Polyethylene – Introduction – Manufacture – Structure and its influence on Properties – Compounding – Curing – Properties and applications. EPM, EDPM – Introduction, Manufacture – Structure and its influence on Properties – Compounding – Curing - Properties and applications.

Reference Books:

1. Hoffmann, Rubber Technology Hand Book, Hanser Publishers Munich– 1989.
2. Anil. K., Bhowmick, Howard L. Stephens (ed.) Hand Book of Elastomers, New
3. Development & Technology, Marcel Decker Inc. New York, 1988
Penn; W. S. (Ed.), Injection Moulding of Elastomers, MacLaren and Sons Ltd., London (1969).
Houwink; R. (Ed.), Elastomers and Plastomers: Their Chemistry, Physics and
Technology, Volume-1 General Theory, Elsevier Publishing Co., Inc., New York (1950).

4. STRENGTH OF MATERIALS (3-1-0) 3 Cr.

Unit – I

Elasticity: Stress and strain, compressive, tensile, shear and bearing stress - Stress - strain diagram, Hooks law, modulus of elasticity, modulus of rigidity, bulk modulus of rigidity, bulk modulus, Poisson's ration. Relationship between elastic constraints and temperature stresses, composite bars, dead, live and shock loads.

Unit – II

Properties of section, calculation of areas, centroid, neutral axis, moment of inertia, modulus of section, radius of gyration with reference to structural shapes.

Unit – III

Theory of simple bends - relationship between load shearing force and bending moment. Bending moment and shear force diagram for cantilever, simple supported and over hanging beams - bending stresses.

Deflection - deflection of beams in simple cases. Principal stresses and strains.

Torsion in solid and hollow shafts - combined bending and torsion.

Unit – IV

Thin and thick cylinders and shells subjected to internal and external pressures.

Unit – V

Column and struts - long and short columns - axial and eccentric loading - effect of end conditions – equivalent length and slenderness ratio - Euler and Rankine formulae.

Total Lectures = 45 Tutorials = 15

References Books:

1. R.S. Khurmi, Applied Mechanics and Strength of Materials S.Chand & Co., (6th ed), New Delhi,
2. P.N. Singh and I.K.Jha, Elementary Mechanics and Solids, Wiley Eastern, New Delhi.
3. Timoshenko, Strength of Materials
4. Singer, Strength of Materials

SESSIONAL / LABORATORY

1. PLASTICS PROCESSING AND TESTING LABORATORY – II (0-0-3) 2 Cr.

1.PLASTIC PROCESSING LAB (25 Hrs)

1. Micro processor controlled Injection moulding machine operation.
2. Automatic Blow Moulding.
3. Vacuum Forming.
4. Rotational Moulding
5. Printing / Welding / Sealing of Plastics
6. FRP hand lay up process
7. Introduction to Mould & Machine Maintenance.

2. PLASTICS TESTING LABORATORY (20 Hrs)

1.	Electrical Lab	:	Dielectric strength, Insulation resistance, (VR/SR), CTI, Arc resistance
2.	Thermal Lab	:	HDT/VSP, Thermal stability shrinkage, flammability – oxygen index.
3.	Optical Properties	:	Gloss, Haze, Clarity, Refractive index, light transmittance.
4.	Rheological Lab	:	Torque Rheometer, MFI, Capillary Rheometer
5.	Characterization Lab	:	DMA, FTIR, SEM, AAS
6.	Product Testing Lab	:	Testing as per National and International standards for various products such as pipes, films, fittings, tanks, cables, containers. Etc.

2. PLASTICS PRODUCT DESIGN & TOOLING – SOFTWARE LABORATORY PART– II (0-0-3) 2 Cr.

1. Two plate mould design-multi impression
2. Three plate mould design (Injection – Multi impression)
3. Split Mould Design (injection)
4. Compression Mould Design

5. Transfer Mould Design
6. Mould Design for Industrial Components
7. Blow Mould Design
8. Extrusion Die Design.

Pre-Thesis work and Seminar (2 Cr.)

Comprehensive Viva –Voce (2 Cr.)

THIRD SEMESTER

THESIS PART-I (14 Cr.)

OPEN ELECTIVE (3-1-0) 3 Cr. (Select any one of the following subjects)

1. QUALITY MANAGEMENT (3-1-0) 3 Cr

1. Basic Concepts of Quality

Introduction to quality – Basic concepts, definition or quality of design and conformance – quality assurance functions – investigational methods – quality circle, organization for quality control, cost of quality, ISO 9000 & their documentation.

2. Data collection and presentation

SQC techniques and their applications – Organising for data collection – summarization of data – presentation of data in the form of bar diagram, histogram, frequency distributions and pie diagram.

3. Measures of central tendency and dispersion

Calculation of mean, Median, Mode, standard deviation & variance – relationship of Mean, Median & Mode, their calculation & interpretation & Probability Distributions, Concept of distributions – Normal, Binominal and Poisson distributions – sampling distributions, t, f and A distributions – Introduction to tests to simple hypothechs.

4. Inspection, Sampling and Correlations Analysis

Variation – Process and product checks – Inspection – In process, patrol – Objections of inspection – 100% inspection concepts of acceptance sampling – single, double and multiple sampling – OC curves and their characteristics. Concept of regression – Concept of correlation – Different types of correlation – Scalter diagrams – Correlation analysis.

Text Book

1. B.L.Agarwal, Basic Statistics, Wiley Eastern Limited, II Chapter
2. Suddhendu Biswas, Statistics of Quality Control, Wiley Eastern Ltd., 1998.
3. Juran & Geyna, Modern Methods for Quality Control and Improvement, John Wiley & Sons, 1986.

2. ENGINEERING ECONOMICS AND COSTING (3-1-0) 3 Cr.

Module – I (10 hours)

Time value of money: simple and compounding interest, Time value equivalence, Compound interest factors, Cash flow diagrams, Calculation, Calculation of time – value equivalences.

Present worth comparisons, comparisons of assets with equal, unequal and infinite lives, comparison of deferred investments, future worth comparison, pay back period comparison.

Module – II (10 hours)

Use and situations for equivalent annual worth comparison, comparison of assets of equal and unequal life. Rate of return, internal rate of return, comparison of IRR with other methods, IRR misconceptions. Analysis of public projects: Benefit / Cost analysis. Quantification of project, cost and benefits, benefit / cost applications, cost – effectiveness analysis.

Module – III (10 hours)

Depreciation, computing depreciation charges, after tax economic comparison, Break-even analysis; linear and non-linear models, sensitivity analysis: single and multiple parameter sensitivity.

Module – IV (10 hours)

Fixed and variable cost, product and process costing, standard costing, cost estimation, relevant cost for decision making, cost estimation, cost control and cost reduction techniques.

Text Books

1. Horn green, C.T., Cost Accounting, Prentice Hall of India.
2. Riggs, J.L., Dedworth, Bedworth, D.B.Randhawa, S.U.Engineering Economics, rw Hill International Edition, 1996, 1996 (Chapter 2,3,4,5,7,8,9,11,12).

3. HUMAN RESOURCE MANAGEMENT (3-1-0) 3 Cr.

UNIT – 1 Human Resource Development Strategies, Design And Experience

Human Resource Development: HRD-An Overview, Line Managers and HRD, Task Analysis, Motivational Aspects of HRD, Developmental Supervision, Counselling and Mentoring , HRD for Health and Family Welfare in Select HRD Culture and Climate, HRD for Workers, HRD/OD Approach to IR Corporate Business,

UNIT – II Basics of Human Resource Planning

Macro Level Scenario of Human Resource Planning, Concepts and Process of Human Resource Planning, Methods and Techniques-Demand Forecasting, Methods and Techniques-Supply Forecasting, Job Evaluation: Concepts, Scope and Limitations, Selection and Recruitment, Induction and Placement, Performance and Potential Appraisal, Transfer, Promotion and Reward Policies, Training and Retraining.

.UNIT – III Wage and Salary Administration

Wage Concepts and Definition of Wages Under Various Labour Legislation, Norms for Wage Determination, Law relating to Payment of Wages and Bonus, Pay Packet Composition, Design of Performance-linked Reward System,

UNIT – IV Labour Legislation

Philosophy of Labour Laws, Labour Laws, Industrial Relations and Human Resource Management, Indian Constitution and Labour Legislations

UNIT – V Personnel Office Management

Functions of the office, correspondence, O & M in personnel departments, Maintenance of Personnel records.

UNIT – V Time Management

Importance of Time factor, Time waster, Prioritizing Work Scheduling, Functions of the Time Office, Flexible Work arrangements.

Reference Books

1. Beardwell and Len Holder, Human Resource Management Macmillan India Ltd.,
2. Graham H.T., & R.Bennet, Human Resource Management – Pitman, London, (1995).
3. Edwin Flippo, Principles of Personnel Management – McGraw Hill.
4. Performance Appraisal, Theory and Practice – AIMA VIKAS Management Series, New Delhi,
5. C.B. Manmoria, Personnel Management – Himalayan Publishing Co., New Delhi.
6. Decenzo / Robbins: Personnel / Human Resource Management, PHI, 2002.
7. Pattanayak: Human Resource Management, PHI, 2002.
8. Nair, N.G. & Latha Nair : Personnel Management and Industrial Relations – S. Chand & Company Ltd., Ram Nagar, New Delhi.
9. Milkovich, G.T & Boudreav, J.W: Personnel Human Resource Management : A diagnostic approach, Ed5,: All India Traveller Book Seller, D

4. MARKETING MANAGEMENT (3-1-0) 3 Cr.

Objective of the Course: The course aims at introducing the basic concepts of marketing to the undergraduate students in engineering. The learning shall help the students in better designing, manufacturing and selling product/ service packages keeping competitive market, customers and cost in view.

Module – I(9 hours)

Marketing Management: Concept, Process, Functions and relevance in the current context.

Marketing Environment: Socio-economic forces. Competition: national and global, Technology, Government Policy, Suppliers, Buyers, Consumer Resistance considerations. Environment scanning tools and techniques

Competition Analysis: Factors contributing to competition, Competition analysis tools, Competitive arena mapping, Segmentation matrix.

Market Planning: Exploring Opportunity, Product –market selection, Approaches to Market Planning, Market Planning Process.

Module II(10 hours)

Market Research and Information Systems: Research Process, The Internet and World Wide Web based Information collection and processing, Database, Data Warehouses and Data Mining, Global Market Research, Competitive Intelligence.

Consumer Behavior: Importance of buyer and his/ her role in purchasing. Influence of buyer behavior, Buyer behavior study tools. Organizational buying behavior.

Market Segmentation, Targeting and Positioning: Definition, Bases and Methods of segmenting consumer and Industrial markets. Target Market strategies: Domestic and global perspective. Market Positioning.

Market Demand Forecasting: Key Terms, Forecasting Tools : Short term tools : Moving average and Exponential smoothing methods, Long-term forecasting Tools : Time series analysis, Econometrics methods, Qualitative tools : Buying Intention Survey, Sales Force Opinion and Delphi Techniques.

Module – III(11 hours)

Product Planning : Product Life Cycle, Locating products in PLC, New Product Development Process, Branding Strategy, Positioning a Brand, Brand Equity, Packaging and Labeling, Product-mix and Product Line, Product-Mix strategies, Planned Obsolescence.

Pricing Decision : Objectives and Factors influencing pricing, Cost-Plus Pricing, Breakeven Analysis, Price Based on Marginal Analysis, Price Elasticity of Demand, Operating statement, Markups Analysis Ratios, Pricing Strategies : Market-Entry, Discounts and allowances, Geographic Pricing, Special Pricing.

Promotion Decisions: Marketing Communication and Promotion Process, Promotion Mix, Advertising: Media and Media selection process. Organizing for advertising, sales promotion.

Module -IV(10 hours)

Channels of Distributions: Designing Distribution Channels, Wholesaling and Physical Distribution, Retailing. Supply Chain Management (Basic only). Personal selling, Direct Marketing, Managing Sales Force.

Trends in Marketing: Global Marketing, Customer Services, Customer Relationship Management, Rural Marketing and Service Marketing.

REFERENCES :

1. M. J. Etazel , B. J. Walker and W. J. Stanton, Marketing, Tata McGraw Hill, 13th Edition,
2. R. Saxena, "Marketing Management" Tata McGraw Hill, second Edition, 2003.

FOURTH SEMESTER

1. **THESIS PART-II (20 Cr.)**
2. **SEMINAR (2 Cr.)**
3. **COMPREHENSIVE VIVA VOCE (2 Cr.)**

ACADEMIC REGULATIONS

FOR M.TECH / M.PHARM / PH.D PROGRAMMES

**BIJU PATNAIK UNIVERSITY OF TECHNOLOGY
ROURKELA, ORISSA
2003-2004**

**REGULATIONS FOR M.TECH / M.PHARM PROGRAMME
(Approved in 1st Meeting of Academic Council held on 05-07.2003)**

1.0 Duration of Curriculum and Calendar

1.1 M.Tech and M.Pharm programmes are of two years duration each. Each year shall be divided into two semesters. First semester shall ordinary begin in September and end in January. Second Semester shall begin in February and end in June. There shall be a summer break of 4 weeks. Sometimes due to delayed in admission formalities, if the first semester (for fresh students) is delayed by few days, the subsequent second semester may be delayed. However,

the loss in academic time have to be made up through extra classes, so that the starting of third semester is not delayed beyond 1st of August, next year.

1.2 M.Tech / M.Pharm programme shall have one year (Two semesters) of course work and one year of a major project work. The major project shall be judged on the basis of a candidate's capability to conduct independent investigation / research.

1.3 The curriculum and syllabus shall be modified with approval of academic council positively one in every three years to keep the same up-to-date. However, minor modifications can be done as and when necessary with the approval of the Vice-Chancellor. The modifications so done shall be placed to the immediate next academic council meeting for ratification.

2.0 Eligibility for Admission and Admission Procedure

Candidates with valid GATE score and non-GATE candidates with minimum of 60 percent marks in aggregate (or CGPA of 6.5 or above in 10.0 point scale) at their B.Tech. / B.E. level for M.Tech programmes and B.Pharm level for M.Pharm programme are eligible.

Individual colleges affiliated to the University and with necessary approval from AICTE and University shall call for applications through press advertisement. Preference shall be given to GATE qualified candidates. The colleges will prepare merit list of all eligible candidates. The college shall submit the merit list and the list of candidates to be admitted to the University. The admission letter will be issued only on approval of the University. There can be a waiting list to admit students against vacant seats.

Admission shall ordinarily close prior to the commencement of the instruction in first semester. No-inter-college transfer shall be allowed. Under extraordinary circumstances however the University may transfer students from one constituent / affiliated institution / college to another in the same programme at any time during the continuation of the programme without assigning any reason for the same. The college / institution to which such candidates are transferred shall have to admit them and allow to complete the programme.

3.0 Eligibility for appearing in Examination

A student shall be eligible to appear in an examination provided he / she pursues a regular course of study in respective department and attends at least 75% of classes in each theoretical, practical and seasonal subjects held during the semester. The attendance shall be considered from the date of admission of the candidate in the institution / college.

Concessions : A student who has been absent on medical ground for a short period or due to participation in cultural, sports, other academic / official assignments in the interest of the institution / college / University / government with prior written permission of the head of the institution / college shall be permitted a maximum of additional concession of 10% of attendance in a semester.

A student shall be admitted to any examination in a subject only if he / she has registered for that subject, paid necessary registration and examination fees in the beginning of the semester.

A candidate shall be allowed in an examination only after he / she is issued an Admit Card for relevant examination by the college. The college shall obtain clearance on eligibility from the University.

4.0 Grading System :

4.1 A letter grading system shall be followed in the University. The uniform grading system to be followed for all Academic Programmes (except Ph.D and D.Sc) shall be as described.

- i) A seven point grading system on base of 10 shall be followed in the University. Categorization of these grades and their correlation shall be as under.

Qualification	Grade	Score on 100 Percentage Points	Point
Outstanding	'O'	100 to 90	10
Excellent	'E'	89 to 80	9
Very Good	'A'	79 to 70	8
Good	'B'	69 to 60	7
Fair	'C'	59 to 50	6
Pass	'D'	49 to 35	4
Failed	'F'	Below 35	2

N.B. Grade C shall be considered as average, Grade D shall be pass Grade for theory and Grade C shall be pass Grade for Practical / Sessional / Project / Seminar / Viva – Voce.

- ii) A transitory letter grade I (carrying points 2) shall be introduced for cases where the results are incomplete. This grade shall automatically be converted into appropriate grade (s) as and when the results are complete.

A student's level of competence shall be categorized by a GRADE POINT AVERAGE to be specified as :

SGPA : Semester grade point average

CGPA : Cumulative grade point average.

Definition of terms :

- a) Point : Integer quawng each letter grade.
- b) Credit : Integer signifying the relative emphasis of individual course item (s) in a semester as indicated by the course structure and syllabus.
- c) Credit Point : (b) x (a) for each course item.
- d) Credit Index : \sum CREDIT POINT of course items in a semester.
- e) Grade Point : Credit Index
Average $\frac{\sum \text{credits}}{\sum \text{credits}}$

SEMESTER GRADE POINT AVERAGE (SGPA)

$$\text{SGPA} = \frac{\text{CREDIT INDEX}}{\sum \text{CREDITS}} \text{ for a semester}$$

CUMULATIVE GRADE POINT AVERAGE (CGPA)

$$\text{CGPA} = \frac{\sum \text{CREDIT INDEX of all previous semester}}{\sum \text{CREDITS of all previous semesters upto a semester}}$$

5.0 Rule of Examinations

5.1 The M.Tech / M.Pharm programme may consist of following items.

4. Theory Items
5. Practical / Laboratory Items
6. Project Items
7. Seminar Items
8. Comprehensive Viva – Voce Items

5.2 At the end of each semester there shall be an examination (here in after called end-semester examination) conducted by the University.

5.3 In addition to the end semester examination, there shall be three class tests, equispaced within a semester. These tests will be conducted and evaluated by the subject teacher and each shall carry equal weight age.

5.4 A candidate securing F grade in an examination has to register in one or more papers, attend all classes for the same and appear at the normal end semester examination. There will be no supplementary examination. The student shall have the option to take a substitute paper in lieu of the paper where he/she has secured F grade. However, the paper shall belong to the same category of the subject item.

5.5 Evaluation of Theory Papers

The performance of a candidate in a subject shall be evaluated based on following components.

- | | |
|--|-------------|
| a) End term comprehensive examination | : 70 Points |
| b) Three class tests of one hour duration each | : 30 Points |

100

Points

The subject teacher shall evaluated the class tests, show the evaluated answer paper to the students and discuss the test problems / projects in the class. He / She will have the responsibility of sending the score to the University. The concerned teacher shall maintain all records for inspection by the University for at least one semester. The Principals shall maintain a copy for records.

5.6 Evaluation of Project

a) Evaluation of project will be done on following points.

- Understanding the relevance : 10 points
Scope and dimension of the project
- Relation to literature / application : 10 points
- Methodology : 10 points
- Quality of Analysis and Results : 10 points
- Interpretations and Conclusions : 10 points
- Report : 30 points

- Defense : 20 points

100 points

- b) The evaluation will be done by committee of teacher where the project supervisor will be member. His evaluation shall carry 50 percentage point weight age. The other members shall have 50 percentage point weight age. For major project, an external expert shall be involved.
- c) Minimum score for a pass in project item is 50 percentage points.
- d) The chairman of the committee shall forward the score within the prescribed date to the University. H / She shall also maintain all record for inspection by the University for at least a semester. He/ She shall submit a copy to the principal for records.

5.7 Evaluation of Laboratory / Practical Works

A Laboratory paper shall have minimum of 5 to a maximum of 10 assignments / experiments. Each assignment shall have equal percentage points as its weightage. The teacher concerned shall evaluate each assignment / experiment based on quality of result, report and general understanding. He / She shall maintain all records for scrutiny by University for one semester. On completion of each assignment / experiment, she evaluation shall be done. The score will be shown to the student and sent to the University with a coy to the principle for records. Minimum score for a pass in laboratory / practical work shall be 50 percentage points.

5.8 Evaluation of Seminar

Seminar performance will be evaluated by a committee of Teachers. It will have the following components.

- (a) Quality of Material : 30 Points
- (b) Quality of Presentation : 30 Points
- (c) Quality and extent of response from other students : 20 Points
- (d) Participation in other presentations : 20 Points

100 Points

5.9 Evaluation of Comprehensive Viva- Voce

- (a) This shall be done by a committee of teachers with participation of an External Expert from an Institution / Industry of repute.
- (b) The chairman of the committee shall forward the score within the prescribed date to the University. He/ She shall also maintain all records for inspection by the University for at least a semester. He/ she shall submit a copy to the principal for records.
- (c) Minimum score for a Pass in Viva – Voce is 50 percentage points

5.10 Pass a Subject Item

A candidates shall pass (clear) a subject if

A. In a Theory paper he / she has secured minimum of

a) In a Theory paper he / she has secured minimum of

- 25 percentage points in end – term examination.
- 12 percentage points from the remaining components.

b) In a practical / Laboratory / Sessional / Seminar / Project Paper he / she has secured minimum of 50 percentage points.

Promotion and Qualification for Degree

Promotion to second year : A candidate shall be eligible to be promoted to second year provided he / she has I or F Grade in not more that two papers with CGPA of 6.0 in all cleared subjects. The candidate shall register for the subjects with I or F grade in corresponding semester along with the next year batch to clear these subjects. There is no supplementary examination.

Credit requirement for the degree : Credit requirements for the Degree shall be minimum of 90 and maximum of 98. The following subject items shall constitute the total credit requirements.

Subject Items	Credit	
	Minimum	Maximum
• Professional Core	20	24
• Professional Elective	20	24
• Projects	40	40
• Seminar	04	04
• Comprehensive Viva-Voce	06	06
Total	90	98

7.0 Time Table for Instructions.

Each constituent / affiliated college has to prepare time table for the subjects (Theory, Practical and Sessional) being offered in a semester at least 15 calendar days before the course wise registration of students to that semester. The time table must also contain the name of the registered teacher who is handling a subject. Each constituent / affiliated college shall have to submit time table at least 10 calendar years before registration.

8.0 Registration of Teachers

- a) Each regular faculty engaged in teaching of a theory paper, supervision of Practical, Sessional and Project work shall be registered teacher of the University.
- b) A teacher of a constituent / affiliated college of the University has to get himself / herself registered in the University before he / she handles the formal instruction. The college shall forward the registration form in prescribed format with necessary fees to the University.
- c) Only a registered teacher of the University shall be permitted to get involved in teaching, invigilation, examination and evaluation process.
- d) The University reserves the rights to cancel the registration of a teacher, if the performance of a teacher is found to be unsatisfactory and his / her conduct is unbecoming of a teacher with our assigning any reason for the action.

**Sd/-
Vice Chancellor &
Chairman Academic Council**

REGULATIONS FOR PH.D DEGREE PROGRAMME
(Approved in 1st Meeting of Academic Council held on 05.07.2003)

1.0 Duration of Curriculum

Doctor of Philosophy (Ph.D) programme is a research based degree programme of the University. A candidate showing enough of evidence on any one or more of the following will be considered for the award of this degree : (i) Contributions to existing body of knowledge, (ii) New interpretation or new applications of existing body of knowledge, (iii) New design of a product / instrument / device / process that is distinctly superior to the existing ones. This the programme can not have fixed duration. The minimum duration of research for admission to Ph.D degree programme shall, however, be :

- i) Two years from the date of enrollment if the candidate is M.Tech / M.Phil / M.Pharm / M.Arch in a subject.
- ii) Three years from the date of enrollment if the candidate is B.Tech / B.Pharm / M.Sc / MBA / B.Arch degree holder.

If a candidate has not been able to submit within 6 years if he / she is M.Tech./ M.Arch / M.Pharm / M.Phil nad 8 years if he / she is B.Tech / B.Pharm / M.Sc. / MBA/ B.Arch from the date of enrollment, his / her enrollment shall automatically stand cancelled. He / she may however go for fresh enrollment with possible a fresh topic of research and an alternate supervisor.

2.0 Eligibility for Admission

One of the following shall be the eligibility criterion for admission to Ph.D Programme of the University.

- i) M.Tech / M.Phil / M.Pharm / M.Arch with minimum of 7.5 CGPA in 10 points scale (or 70 percent or more in aggregate) at Masters level and minimum of 6.5 CGPA (or 60 percent mark in aggregate) at Bachelor Level.
- ii) B.Tech. / B.Pharm / M.Sc. / B.Arch / MBA / MCA with a normally good academic career and not less that 7.5 CGPA (70 percent marks) at bachelors level.
- iii) GATE qualified candidates (with not less than 85 percentile score) / NET qualified candidates.

Above requirements may be relaxed for the following.

1. Faculty members of Constituent and affiliated colleges.
2. Candidates working in sponsored projects in Constituent and affiliated colleges if the project duration is not less than two years.

3. Candidates working in National Laboratories, R & D Institutions of the Central / State Departments and R & D Laboratories of Reputed Industries in permanent positions.

Admission Procedure

- i) University shall advertise for selection of Ph.D scholar twice a year one in December and the other in June every year.
- ii) A candidate can apply any time for Ph.D programme in prescribed format with prescribed fee approved by the University. Only teachers of constituent / affiliated colleges and candidates sponsored by R & D Laboratories / Institution can avail this facility.
- iii) The candidates will be selected based on the performance in written test or interview or both by a selection committee constituted by the University. A broad discipline (e.g. Electrical Engineering, Mechanical Engineering etc.) will have a common selection committee.

3.0 Enrollment of the Candidates

- Each admitted candidate shall be first enrolled as a research of the University.
- For each enrolled candidate there will be a Doctoral Scrutiny Committee (DSC).
- Each candidate must have a supervisor from the University or its colleges. There may be co-supervisor if a research topic is interdisciplinary in nature or the candidate wants to do a part of or full research in a R&D laboratory / Research Institution / Industry.

The Doctoral Scrutiny Committee (DSC) shall have the following compositions.

- Head of the Department – Chairman
- Supervisor (s)
- Two subject experts that may include one member from other Institution / University.
- One member from an allied discipline.
- On recommendation of the head of the Department and Chairman Research programme Committee of the University, Vice Chancellor shall approve the DSC for each candidate.
- The DSC shall meet at least once in a semester to review the progress of a candidates work. An enrolled / registered candidate has to present and defend his / her work in an open seminar minimum once per semester where majority of the DSC members shall be present.
- The DSC shall monitor the progress and ensure that University Regulations on the matter are strictly adhered to.

4.0 Course Work

Course work shall form an integral part of Ph.D programme. A candidate with M.Tech / M.Arch / M.Pharm / M.Phil degree has to clear minimum of 3 courses (12 credits) and those with Bachelor's Degree have to take 6 courses (24 credits) with minimum of C grade in each subject. Wherever

M.Tech / Ph.D level courses. All such self study courses have to be evaluated based on a written examination of 2 hours duration followed by a viva-voce examination of one hour duration.

5.0 Registration of Candidate

A candidate on completion of course works shall submit a research proposal through DSC for consideration of the University. Each such research proposal have be evaluated through a comprehensive oral examination by DSC with an additional expert to be appointed by the University. Chairman RPC (Research Programme Committee) shall be its Ex –Officio Chairman. On successful clearance of the comprehensive examination, a candidate shall register for Ph.D. degree of the University.

6.0 Submission and Evaluation of Thesis

On completion of the work and the minimum stipulated period from date of enrollment, the candidate shall submit a synopsis and adequate number of soft copies of the thesis to the University. The copies will be sent to DSC members and two experts within the country for evaluation and comments.

The candidate shall defend his work through an oral presentation and Viva-voce. The members shall be DSC members and the two experts.

The candidate is required to incorporate the necessary changes suggested by the DSC and experts and submit the thesis in final form to the satisfaction of the DSC.

Panel of Examination: The DSC shall make list of experts in two separate panels : One from India and the other from abroad. Each panel shall have minimum 5 members. An expert shall not be below the rank of a professor and must have contributions in the line of research or related areas.

Examination Process

The synopsis shall be sent simultaneously to three experts, one from Indian Panel, Second from foreign panel and third to the supervisor. On receipt of their acceptance, the thesis shall be sent for evaluation. If an examiner declines, another examiner from the same panel shall be contacted.

An examiner shall evaluate the thesis and give his recommendation in one of the following three ways.

- Accepted in the present form
- Accepted with suggested modifications
- Rejected

In addition he/she has to give his/her specific comment on strength, weakness, scope of extensions and reasons behind his/her decision. If an examiner suggests modification, the same must be done and the modified thesis within maximum of six months should be submitted for reexamination to the same examiner.

Award to Degree

For award of the PH.D degree to a candidate

- a) The three reports from examiners must be favourable and unanimous.
- b) If two are favourable, and third is not, the thesis may be sent to another examiner from the same panel (Indian or foreign) and his / her decision shall be final.
- c) If two or more examiners have reservations in awarding the degree, the thesis shall be rejected and the candidate shall not be awarded Ph.D degree.

Research Programme Committee

Constitution

Research Programme Committee shall have following members.

- The Deans of the University
- A nominee of Vice Chancellor
- Two members from Academic Council from outside the University (BPUT) system.
- The chairman of the committee shall be selected from out of the members by Vice-chancellor for a period of 3 years.

The Functions

The functions of the RPC shall include

**Sd/-
Vice Chancellor &
Chairman Academic Council**

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