# M.TECH IN PLASTICS ENGINEERING

**FROM THE ACADEMIC SESSION: 2009-2010**

## FIRST SEMESTER

<table>
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<tr>
<th>Nature/Parameter</th>
<th>No. of Subjects</th>
<th>Credits</th>
<th>Remarks</th>
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<tr>
<td>Pre-Thesis work and Seminar</td>
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## SECOND SEMESTER

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## THIRD SEMESTER

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## FOURTH SEMESTER

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**GRANT TOTAL**: 90

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

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</table>
# M.TECH IN PLASTICS ENGINEERING

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

## FIRST SEMESTER

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<thead>
<tr>
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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 Packaing.

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

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, cellulosics, nylons, aromatic polyamides and polyimides, PET, PBT and aromatic polyesters, fluoro polymers, polycarbonates, polyacetals, aromatic polyether/ polysulfones / polyphenelens / polyetheretherketone / polyurethanes / Thermoplastics / Thermosets).
4. Comparative properties and applications
   Thermosetting plastics : Formaldehyde resins (PF/UF/MF), Epoxy resins, unsaturated polyesters, silicones.

TEXT BOOKS :
2. Fred W.Billmeyer, Jr., “Text Book of Polymer Science”, John Wiley and Sons, Singapore

2. ADDITIVES AND COMPOUNIDNG (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.

Text Books :
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.


3. Compression and transfer moldings: Introduction and principles, machine process and process variable, product defects and remedies, comparison between the above-mentioned process.


TEXT BOOKS:


ELECTIVE SUBJECTS

ELECTIVE – I (Any one of the following subjects)

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

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:

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:

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
2. Salvadorei and Mc Carmik: Numerical Methods

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.

TEXT BOOKS
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.

TEXT BOOKS
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

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

Reference Books
1. Plastic Design & Processing - By Sharma, S.C
2. Plastics Moulds & Dies - By Sors, & Others
   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.


Text Books

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, acrylicas, polypropylene, glass and carbon-fibres. General principles of finishing and dying of fibers. Common types of finishes applied to textile fibers.

Reference Books


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)
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.
test – Flame test – Chemical tests.

UNIT – II : Physical Testing
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 – Crazing.
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

UNIT – IV : Permanence Properties and Product Testing
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
3. Analysis & Testing by Crompton.
Text Books


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.
Interchain forces in polyblends, interpenetrating polymer network in polyblends, morphology and phase separation.

Preparation, processing and properties, characterization techniques rheology of polyblends and alloys.

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 :**


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 : paint 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**


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.
4. Testing and evaluation: in-vitro-/vivo; Standards in product development and regulations; Ethical and sociological issues.

Books

4. BIODEGRADABLE PLASTICS (3-1-0) 3 Cr.
2. Renewable resources, synthetic & natural plastics, Biodegradable starch based polymers, Microbial Polyamino acid, Lignum, Alginlate 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

Text Books
2. Gerald Scott & Dan Gilad, Degradable Polymer – Principles & Applications, Chapman & Hall,
3. Y.Do and K.Fukuda (Eds), Biodegradable Plastics and Polymers, Elsevier (1994)

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.


Text Book:

2. MECHANICAL BEHAVIOUR OF POLYMERS (3-1-0) 3 Cr.
   4. Thermo mechanical behavior and analysis.

Text Books :

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.
   3. Waste recycling and pollution control.
   4. Environmental issues, policies and legislation in India.

Text Book
3. Ministry Of Environments - Publications
4. POLYMER DEGRADATION AND STABILISATION (3-1-0) 3 Cr.

Unit I

Unit II

Unit III

Unit IV

Unit V

Reference Books:

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.

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)

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 :
3. Chary, S.N. Production & Operations Management (TMH)

2. NYLON TECHNOLOGY (3-1-0)

Unit I

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, BGG molecular 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.


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

Polymer Blends Alloys And Composites: Properties—factors affecting the properties of nylon, 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:

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

Unit I

Unit II
Unit III

Unit IV

Unit V

Reference Books:

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

Unit – I
Elasticity: Stress and strain, compressive, tensile, shear and bearing stress - Stress - strain diagram, Hook's 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:
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.
   4. Rotational Moulding
   5. Printing / Welding / Sealing of Plastics
   6. FRP hand lay up process

   2. PLASTICS TESTING LABORATORY (20 Hrs)
   1. Electrical Lab : Dielectric strength, Insulation resistance, (VR/SR), CTI, Arc resistance
   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 hypothecs.
   4. Inspection, Sampling and Correlations Analysis

Text Book
1. B.L.Agarwal, Basic Statistics, Wiley Eastern Limited, II Chapter

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

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

UNIT – I 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

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

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.,
4. Performance Appraisal, Theory and Practice – AIMA VIKAS Management Series, New Delhi,
8. Nair, N.G. & Latha Nair : Personnel Management and Industrial Relations –
   S. Chand & Company Ltd., Ram Nagar, New Delhi.
   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.
Competition Analysis: Factors contributing to competition, Competition analysis tools, Competitive arena mapping, Segmentation matrix.

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 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)**


**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.


**REFERENCES:**

**FOURTH SEMESTER**

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

********
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 in 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 candidates 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 called 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 obtaining 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 (expect 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.

<table>
<thead>
<tr>
<th>Qualification</th>
<th>Grade</th>
<th>Score on 100 Percentage Points</th>
<th>Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outstanding</td>
<td>‘O’</td>
<td>100 to 90</td>
<td>10</td>
</tr>
<tr>
<td>Excellent</td>
<td>‘E’</td>
<td>89 to 80</td>
<td>9</td>
</tr>
<tr>
<td>Very Good</td>
<td>‘A’</td>
<td>79 to 70</td>
<td>8</td>
</tr>
<tr>
<td>Good</td>
<td>‘B’</td>
<td>69 to 60</td>
<td>7</td>
</tr>
<tr>
<td>Fair</td>
<td>‘C’</td>
<td>59 to 50</td>
<td>6</td>
</tr>
<tr>
<td>Pass</td>
<td>‘D’</td>
<td>49 to 35</td>
<td>4</td>
</tr>
<tr>
<td>Failed</td>
<td>‘F’</td>
<td>Below 35</td>
<td>2</td>
</tr>
</tbody>
</table>

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 : ∑ CREDIT POINT of course items in a semester.

e) Grade Point : Credit Index

Average \[ \sum \text{ credits} \]
SEMESTER GRADE POINT AVERAGE (SGPA)

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

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
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 candidate 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 than 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.

<table>
<thead>
<tr>
<th>Subject Items</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional Core</td>
<td>20</td>
<td>24</td>
</tr>
<tr>
<td>Professional Elective</td>
<td>20</td>
<td>24</td>
</tr>
<tr>
<td>Projects</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Seminar</td>
<td>04</td>
<td>04</td>
</tr>
<tr>
<td>Comprehensive Viva-Voce</td>
<td>06</td>
<td>06</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>90</strong></td>
<td><strong>98</strong></td>
</tr>
</tbody>
</table>

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
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.

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