UNIVERSITY OF MUMBAI
No.UG/ 404 of 2004

CIRCULAR :

A reference is invited to the Ordinances and Regulations relating to the Master of Engineering Production Engg., Specialization in Manufacturing Engg (Part-time Degree Course) vide this office Circular No.UG/509 of 2002 dated 28th November, 2002 and the Principals of the affiliated colleges in Engineering are hereby informed that the recommendation made by the Board of Studies in Mechanical Engineering at its meeting held on 5th February, 2004 has been accepted by the Academic Council at its meeting held on 2nd April, 2004 vide item No.4.19 and subsequently approved by the Management Council at its meeting held on 17th April, 2004 (vide item No.20) and that in accordance therewith the syllabus of Master of Engineering (M.E.) Production Engineering – Specialization in Manufacturing Engineering (Part-time Degree Course) has been revised as per appendix.

They are further informed that in exercise of the powers conferred on the Management Council under Section 54(1) of the Maharashtra Universities Act 1994, the Management Council has made the Ordinance 5394, 5395, 5396, 5397, 5398, 5399, 5400, 5401, 5402, 5403, 5404, 5405, 5406, 5407 and 5408 relating to the scheme of papers and standard of passing for the Master of Engineering (M.E.) – Production Engineering - specialization in Manufacturing Engg. (Part-time Degree Course) is as per Appendix and that the same has been brought into force with effect from the academic year 2004-2005.

They are also informed that in exercise of the powers conferred on the Management Council under Section 55(1) of the Maharashtra Universities Act 1994, the Management Council has made the Regulations 4711, 4712, 4713, 4714, 4715, 4716 and 4717 relating to the scheme of papers and standard of passing for the Master of Engineering (M.E.) – Production Engineering - specialization in Manufacturing Engineering (Part-time Degree Course) is as per Appendix and that the same has been brought into force with effect from the academic year 2004-2005.

Mumbai 400 032
16th September, 2004

for I/c REGISTRAR

To,
The Principals of the affiliated colleges in Engineering.

A.C. 4.19/02.04.2004

...2

No.UG/ 404-A of 2004 16th September, 20

Copy forwarded with compliments to the :-

1) the Dean, Faculty of Technology.
2) the Chairman, Board of Studies in Mechanical Engineering.

for I/c REGISTRA

Copy to :

The Director, Board of College and University Development, the Controller Examinations the Deputy Registrar (Eligibility & Migration Section), t Director of Students welfare, the Personal Assistants to the Vice-Chancello the Pro-Vice-Chancellor, the Registrar and the Assistant Registra Administrative sub-centre, Ratnagiri, for information.

The Controller of Examinations (10 copies), F. & A.O. (Accounts Section) Fo (2 copies), Record Section (5 copies), Publication Section (5 copies), D.R (Enrolment, Eligibility & Migration Section) (3 copies), D.R., Statistical Uni (2 copies), D.R., (Accounts Section), Vidyanagari (2 copies), the Director U.C.C., I.D.E. Bldg., D.R., (Affiliation Section) (2 copies), D.R., (P.R.O.) (2 copies), A.R., E.A.U. (2 copies), A.R., A.A. Unit (2 copies). He is requested t treat this as action taken report on the concerned resolution adopted by the Academic Council/Management Council referred to in the above Circular and that no separate A.T.R. will be sent in this connection. A.R., CONCOL (2 copies), BUCTU (1 copy), Dy.Acct. (UnitV) (1 copy), Incharge, Central Computing Facility (1 copy), Receptionist (1 copy), Telephone Operator (1 copy), Secretary, MUASA (1 copy), Superintendent, P.G. Section (2 copies).

NSE Cir 1-150604

A. C. Item No. 4.19 dt. 2/4/2004.

UNIVERSITY OF MUMBAI

Revised Syllabus

for

Master of Engineering - (M.E.)

Production Engineering - Specialisation in Manufacturing Engineering

(Part Time Degree Course)

(with effect from the academic year 2004-2005)

UNIVERSITY OF MUMBAI

Ordinance and Regulations Relating to Examination for the Degree of Master of Engineering – Production Engineering – Specialization in Manufacturing Engineering (Part Time) Degree Course.

O.5394 A Candidate for being eligible for admission to the Master of Engineering (M.E.) in Production Engineering with specialization in Manufacturing Engineering, Part Time Course must have passed the degree of Bachelor of Engineering in Mechanical Engg., Production Engg., Automobile Engg. Or Machine Tool Engg. of this University or of Bachelor of Engg. in the aforesaid branches of any other University recognized as equivalent to B.E. of this University or must have passed the examinations conducted by the Institution of Engineers (INDIA) and qualify to become A.M.I.E. (India) (Associate Member of Institution of Engineers) in the aforesaid branches.

A candidate must have a minimum two years of full-time work experience in a registered firm/company/industry/educational and research institutions/any Government Departments or Government Autonomous Organizations in the relevant field in which admission is being sought.

O.5395 The M.E. (Production Engineering with specialization in Manufacturing Engineering) Degree Examination (Part Time Degree Course) shall consist of theory papers, term work, seminar on dissertation and Viva-Voce. The term work in any subject will include laboratory practicals, home assignments, in class assignments, design/drawing work, field visits, collection of data and analysis, written/oral tests, seminars etc. as specified in R(7). It shall be assessed internally on a continual basis. The entire course shall be grouped into seven semesters as detailed in R.8.

O5396 A candidate will be eligible to appear for Semester I examination if he has satisfactorily completed the course for that Semester.

O.5397 A candidate will be eligible to enter upon Sem. II on satisfactory completion of Sem. I.

O.5398 A candidate will be eligible to appear for Semester II examination if he has satisfactorily completed the course for that semester.

O.5399 A candidate who has passed either Semester I examination or Semester II examination will be permitted to enter upon the course for Semester III.

O.5400 A candidate will be eligible to appear for Semester III examination if he has satisfactorily completed the course for that semester.

O.5401 A candidate who has appeared simultaneously for Semester I/II and Semester III examinations and has failed in Semester I/II examination, but has, however obtained passing marks in all the subjects and 50 percent of aggregate marks of Semester III examination as specified in R.1 will not be declared to have passed the semester III examination unless he passes Semester I/II examination. Such a candidate will however be permitted to enter upon the course for Semester IV.

O.5402 A candidate who has satisfactorily completed the Course for Semester III will be permitted to enter upon the course for Semester IV.

O.5403 A candidate who has satisfactorily completed the Course for Semester IV and has passed Semester I and II examinations previously will be eligible to appear for Semester IV examination along with any pending subjects of Semester III examinations.

O.5404 A candidate who has passed either Semester III examination or Semester IV examination will be permitted to enter upon the course for Semester V.

O.5405 A candidate who has satisfactorily completed the course for Sem. V will be permitted to enter upon the course for Sem. VI.

O.5406 A candidate who has satisfactorily completed seminar and dissertation for Sem. VI and has passed Sem. III and IV examination previously will be eligible to appear for Sem. VI examination.

O.5407 A candidate who has satisfactorily completed Sem. VI will be permitted to enter upon Sem. VII.

O.5408 A candidate who has satisfactorily completed pre synopsis dissertation seminar of Sem. VII and has passed Sem. V & VI examination will be eligible to appear for Sem. VII examination.

STANDARD FOR PASSING THE EXAMINATION

R.4711 To pass the Semester I, II, III, IV & V examination for M.E. (Production Engineering with specialization in Manufacutring Engineering) (Part Time Course), a candidate must obtain at least 45 percent of the marks obtainable in each of i) Theory Papers individually and ii) Term Work individually and 50 percent of the aggregated marks assigned to each semester. To pass in sem. VI examination a candidate must obtain atleast 50% of marks in each Seminar as Special Topics and Dissertation Seminar.

To pass sem. VII examination a candidate must obtain at least 50% of the marks obtainable in each of i) pre-synopsis dissertation seminar and ii) Dissertation & Viva-Voce, Term work & Viva separately.

Those of the candidate who fail to obtain 45% marks in term work shall improve upon their term work and submit the same for assignment again. Those who fail to get 50% in Dissertation Seminar or pre synopsis Seminar will give another seminar in subsequent semesters subject to provision R.3888 for obtaining a class.

R.4712 Those successful candidates who have obtained 50% and above but below 60% of the aggregate marks in the seven semesters taken together and those who have obtained 60 % and above but below 70% marks of the aggregate marks in the seven semesters taken together and those who have obtained 70 percent and above of the aggregate marks in the seven semester taken together shall be declared to have passed the M.E. (Production Engineering with specialization in Manufacturlng Engineering) (Part Time Course), examination in Second Class, First Class and First class with Distinction respectively.

R.4713 In order to be eligible for a class, the candidate must appear and pass the First five semester examinations in not more than seven consecutive semesters after registration with a provision that each semester examination has to be cleared in not more than two sittings, further the candidate shall submit dissertation within a period of nine semester or 28th February of the fifth academic year after Registration whichever is later. This rule is subject to the Ordinances 0.3378 to 0.3391 governing eligibility for admission to semesters I to VII and appearance at the examination conducted at the end of the semester I to VII.

R.4714 Those of the candidates who obtain 45% of the total marks obtainable in each theory paper and term work separately and 50 percent marks on the aggregate of the marks assigned to each semester shall be declared to have passed the Semester I, II, III, IV or V examination as the case may be. Those of the candidate who obtain 50 percent in Seminar on Special Topics and 50 percent marks on dissertation Topic Stage-I shall be declared to have passed the Semester VI examination. Those of the candidates who obtain 50 percent of marks in pre synopsis dissertation seminar and Dissertation Viva-voce separately shall be declared to have passed the Semester VII examination.

R.4715 A candidate who fails in any of the semester I,II,III,IV & V examinations but secures 50 percent or more of the total marks in any theory paper and term work taken together, may, at his option be exempted from reappearing for the same at a subsequent attempt and will be declared to have passed the relevant Semester examination when he has passed in the remaining papers in accordance with R.1. The marks for term work will be carried over to subsequent examination and will be considered along with marks for theory paper for award of a class.

R. 4716 For the purpose of deciding whether a candidate has secured 50 percent of the aggregate marks in any of the semesters I,II,III,IV & V , the marks of the candidate at the previous examination in the theory paper or papers in ehich he has exempted shall be carried over.

A candidate passing the examination in this manner shall not be eligible for a prize / scholarship to be awarded at the examination.

The weightage for written tests shall not be less than 40 percent of the total marks assigned for term work. The term work shall be assessed by the teachers concerned on a continual basis.

Seminar on Special Topics, Dissertation Seminar, pre synopsis Seminar shall also be assessed internally by the concerned teachers.

The dissertation may consist of a detailed report of any analytical/investigation done by the candidate or a comprehensive and critical review of any recent development on the subject or a detailed report of any important design or development work that the candidate has excecuted on his own or a case study or on the Development of software for design & development / managerial problem.

Stage 1 Seminar on dissertation shall be conducted at the end of sixth semester and pre synopsis dissertation seminar shall be conducted at the end of the about eight weeks after the commencement of semester VII and shall be assessed by departmental committee connected with course.

The dissertation work will be submitted to the University in a typed and bound form and it shall be jointly assessed by an internal and an external examiner. The assessment shall consist of 100 marks for the dissertation work and 100 marks for the Viva-Voce.

R.4717 The schemes of instruction and examination and syllabi for M.E. (Production Engineering with specialization in Manufacturing Engineering) (Part Time Course) examination are as under :-

M.E. (MANUFACTURING ENGINEERING)
With Specialization in Manufacturing Engineering
Seven Semester Part Time — Scheme of Instructions and Examinations

Sem	Code	Subject	Scheme of instruction (Hours per week)		Scheme of examination			
			Lecture	Practical	Duration Hours	Theory	T/W	Viva-Voce
I	1.01	Material Removal Science	4	2	4	100	50	-
	1.02	Material Science	4	2	4	100	50	-
II	2.01	Manufacturing Management	4	2	4	100	50	-
	2.02	Advanced Material Joining & Sheet Metal Processing	4	2	4	100	50	-
III	3.01	Automation & Control	4	2	4	100	50	-
	3.02	Quality Management	4	2	4	100	50	-
IV	4.01	CAD/CAM/CIM	4	2	4	100	50	-
	4.02	Process Planning & Tooling	4	2	4	100	50	-
V	5.01	Economic Analysis & Manufacturing Strategies	4	2	4	100	50	-
	5.02	Elective I (any one) 1. Entrepreneurship & Project Management 2. Product Design 3. Plastic Engineering 4. Material Forming Technology.	4	2	4	100	50	-
VI	6.01	Seminar on Special Topics	-	4	-	-	50	-
	6.02	Dissertation Seminar	-	-	-	-	50	-
VII	7.01	Pre-synopsis Dissertation Seminar	-	-	-	-	50	-
	7.02	Dissertation & Viva-Voce	-	-	-	-	100	100
			TOTAL			1000	750	100
			GRAND TOTAL					1850

1.01 Material Removal Science

Theory : 4 Periods
Term Work : 2 periods
Marks : Theory : 100
Termwork : 50

PART A :

I. Introduction to Machining Processes. Development of machine tools and cutting tool materials along with the level of controls.

II. Fundamentals of the machining processes:
- Mechanics of Chip Formation
- Forces, power & stresses in machining
- Surface finish & surface integrity
- Tool wear & tool life
- Machining Economics
- Experimental methods to find tool life
- Relationship exponents & constants.
- Tool force dynamometers

III. Cutting tool materials
- High Speed Tool Steel
- Cast Cobalt alloys
- Cemented carbides
- Cermets
- Ceramics, Ultra hard tool materials

IV. Machinability of materials, their prediction and improvement.
- Cutting Fluids & surface roughness, Advancements in Cutting tool material.
- Recent developments in toolings for CNC machine applications.

V. Nomenclature of Cutting tools. Systems of cutting tool Nomenclature American Standard Association System, German System, British Maximum Rake System., Interrelationship among different systems of Rake & Clearance angles of Turning Tools.

VI. Design of Cutting Tools :
- H.S.S. & Tungsten Carbide single point Turning tools.
- Flat & Circular Form Tools
- H.S.S. Broaches for holes, keyways and splines
- H.S.S. Drill and Reamers.
- Form relieved Milling Cutters such as Involute gear tooth disc type and End Mill type cutters.
- H.S.S. Hobbing & Shaper cutters.

PART B : Non Traditional Machining Processes :

VII. NTM Processes : Classification, Comparison of Equipments and Process capabilities.

Mechanical processes	:	Abrasive Jet Machining, Water Jet machining Ultrasonic Machining
Electrical Processes	:	Electrochemical Machining Electrochemical Grinding Electrochemical Deburring
Thermal Processes	:	Electron Beam Machining Laser Beam Machining Electrical Discharge Machining.
Chemical Process	:	Chemical Machining Chemical Engraving Photochemical Machining.

VIII. Material Removal Analysis of AJM, USM, & ECM processes.
Design of Tool Head in USM.

IX. NTM application to VLSI (Very Large Scale Integration) Technology.

Term Work :

1. Tool Nomenclature (MRS, ORS, NRS) and related interrelationships.
2. Numerical examples in Metal Cutting and machining economics.
3. Design sheets for Flat & Circular form tools, H.S.S. broaches, H.S.S. Drills and Reamers and Form Milling cutters.
4. Practical Experiments for chip formation and Tool force measurements.
5. Case studies in Nontraditional machining through seminars.
6. Case studies in Metal Cutting topics other than Nontraditional machining through seminars.

Text Books / References :

1. ASM Handbook , Vol 16 : Machining , ASM International Materials park, Printed in USA, 1999.
2. Metal Cutting Theory & Practice , Bhattachrya A., New Central Book Agency, 1969.
3. Fundamentals of Metal Machining and Machine tools, Boothroyd G., Tata McGraw Hill, 1975.
4. Typical examples and solutions in Metal Cutting , Osipov, Mir Publications
5. Non Traditional Machining Processes, Weller, SME, 1984
6. Non Traditional machining Conference Proceeding, Society of Carbide and Tool Engineers, 1985.
7. VLSI Technology by S. M. Sze.

1.02 MATERIAL SCIENCE

Theory	4 periods
Term Work	2 periods
Theory	100 Marks
Term Work	50 Marks

Objective : To study and analyze the role of Materials in manufacturing technology.

Approach : Emphasis on conceptual understanding and fundamental problem solving.

Weightage : Equal weightage on all chapters.

METALS AND ALLOYS:

A. Review of Fundamentals:
Covalent, Ionic, Metallic and Van der Walls Bond, Bond strength and Melting Point, Crystalline Structures, Vacancies, Dislocations and Other Crystal Defects.
Metals vs Alloys – Micro structural Characterisation.

B. Mechanical Behaviour of Metals and Alloys:
Tensile and Compressive Stress-Strain Relations, Fracture Toughness, Fatigue, Creep, Wear and Abrasion.

C. Metallic Materials for Engineering Applications:
HSLA steels, Tool and Die Materials, Alloy Cast Irons, Stainless Steels, PH-and Maraging Steels, Materials for Low Temperature Applications, Refractory Metals and Superalloys, Hadfield Steels, Ball bearing Steels and Bearing Metals, Automobile Alloys and Aerospace Alloys.

D. Environmental Effects in Metals and Alloys.

2. POLYMERS:

A. Structure of Plastics:
Distinction between Polymers and Plastics; Monomers and Polymers; Addition Polymerization, Condensation Polymerization, Carbon Backbone with Linear Chain, Branched Chain or Cross-Linked Chain.
Branching and Tacticity – Isotactic, Syndiotactic, Atactic Forms
Copolymer – Alternating, Random, Block and Graff Copolymers.
Crystalline Structure of Polymers –
Fringed Micelle Model, Folded Chain Theory, Lamellae and Spherulites in Crystalline Polymers.

B. Types of Plastics:
Thermoplastic Materials – Crystalline and Amorphons, Thermosetting Plastics, Structural Foam, Elastomers and Thermoplastic Elastomers, Polymer Alloys and Liquid Crystal Polymers.

C. Viscoelastic, Thermal, Electrical and Optical Behaviour of Polymers.

D. **Mechanical Behaviour of Polymers:**
Strength and Stiffness, Notched Impact Toughness, Flexural Modulus, Creep and Relaxation, Fatigue.

E. **Engineering Polymers and Their Applications.**
Polyethylene, ABS, Polyamide (Nylon), Polycarbonate, Polysulphone, PEEK.

F. **Environmental Effects in Polymers.**

3. **CERAMICS:**

A. **Ceramic Crystal Structures –**
Binary Ceramic Structures:
[Rock Salt], [Fluorite], [Rutile] and [Silica] Structures.
Ternary Ceramic Structures:
[Perovskite] Structure.

B. **Introduction to Phase Equilibria in Ceramics:**
Phase Equilibrium Diagrams and Composition Calculations.

C. **Thermal, Electrical, Magnetic and Optical Behaviour of Ceramics.**

D. **Mechanical Behaviour of Ceramics:**
Toughening Mechanisms in Ceramics, Cyclic Fatigue of Ceramics, Thermal Stress in Ceramics, Creep in Ceramics,

E. **Ceramics for Engineering Applications:**
Engineering Ceramics and Their Applications, (Glass and Glass-Ceramics, Aluminium Oxide, Silicon Nitride, Zirconia and Zirconia-Toughened Aluminium, Sialons).

F. **Environmental Effects in Ceramics.**

4. **COMPOSITES:**

A. **Fundamentals:**
Definition; Classification of Composite Materials; Laws of Mixtures, Factors affecting Composite Properties; Interfacial Bonding.

B. **Mechanical Bahaviour of Composites:**
Young's Modulus and Strength Considerations for continuous FRCs and short FRCs, Halpin-Tsai Equations.

C. **Interfacial Mechanics:**
Mechanics of Load Transfer from Matrix to Fiber, Toughening Machanisms in Composites.

D. **Fabrication and Properties of Fibers –**
Glass Fibres, Carbon Fibres, Aramid Fibres, Silicon Carbide Fibres and Metallic Glasses.

E. **Comparative Study, Illustrations and Applications:**
PMCs, CMCs and MMCs.

F. **Fatigue of Laminate Composites.**

TERM WORK:

The termwork will comprise of at least four assignments on theory and ten problems based on the above syllabus and one seminar report based on actual presentation of related advanced topics and current literature survey.

REFERENCES:

METALS AND ALLOYS:

1. Material Science by R.S. Khurmi & R.S. Sedha (S. Chand & Company Ltd.).
2. Mechanical Behaviour of Materials by Thomas H. Courtney (McGraw-Hill).
3. Mechanical Metallurgy by George E. Dieter (McGraw-Hill).
4. Engineering Metallurgy – Part I & II by Ramond A. Higgins, (ELBS).
5. Heat Treatment Principles and Techniques by Rajan, Sharma & Sharma (Prentice-Hall of India).
6. Elements of Materials Science and Engineering by Lawrence H. Van Vlack (Addison – Wesley Publishing Company).
7. Principles of Materials Science & Engineering by William F. Smith (McGraw Hill Publishing Company).
8. The Science & Engineering of Materials by D.R.Askeland & P.P.Phule' (Thomson Asia Pte Ltd.,Singapore) .

POLYMERS:

9. Plastics Engineering by R.J. Crawford (Butterworth-Heinemann).
10. Plastics Technology Handbook by M. Chanda & S.K. Roy (Marcel Dekker, Inc.)
11. Plastics Mould Engineering by DuBois, J.H. and Pribble, W.I. (Van Nostrand Reinhold, New York).
12. Plastics Engineering Handbook of the Society of Plastics Industry, Inc. by Frados, J. (Van Nostrand Reinhold, New York).
13. Engineering Materials And Their Applications by R.A. Flinn and P.K. Trojan (Jaico Publishing House).

CERAMICS:

14. Engineering Materials And Their Applications by R.A. Flinn and P.K. Trojan (Jaico Publishing House, India).
15. Materials Science by J.C. Anderson, K.D. Leaver, R.D. Rawlings and J.M. Alexander (Chapman And Hall).
16. Mechanical Properties of Ceramics by John B. Wactman (John Wiley & Sons, Inc.)
17. Modern Ceramic Engineering Properties, Processing & Use in Design by David W. Richerson (Marcel Dekker, Inc.)

COMPOSITES:

18. Composite Materials: Engg. And Science by F.L. Matthews and R.D. Rawlings (Chapman and Hall).

19. Composite Materials Science and Engineering by Krishan K. Chawla (Springer-Verlag).

20. Metal Matrix Composites: Thermomechanical Behaviour, by Taya M., Arsenault R. J. (Pergamon Press, Oxford).

21. Analysis and Performance of Fiber Composites, by B.D. Agarwal and L.J. Broutman (John Wiley & Sons, New York).

2.01 Manufacturing Management

Theory : 4 periods
Termwork : 2 periods
Marks : Theory : 100
Termwork : 50

1. A system view of manufacturing - different systems - job order, intermittent & continuous systems. Issues & complexities. Design – Manufacturing – Marketing interface. Elements of the manufacturing system.
2. Demand forecasting : Time series analysis. Exponential smoothing, fitting a curve, Holt's method, seasonal variation.
3. Aggregate planning : Options for uniform production versus production according to demand. Cost associated with inventory, backorders, changes in production loads through change in workforce, subcontract, overtime, etc.
4. Capacity planning : Bottleneck operation. Short term capacity to long term capacity.
5. Line production – Line balancing and workstation design – Assembly lines & production lines, Material handling systems in line production.
6. Intermittent production – Plant layout, types of layout, material handling systems, Group technology & Cellular manufacturing. Cell design – Group layout. Lot size decision. Production planning & Scheduling. Shop floor control.
7. Job order systems – System features, Scheduling, Sequencing, PERT/CPM, Load leveling.
8. Material Planning & Control – Inventory Systems. Integrated approach to materials management.
9. MRP based manufacturing systems. Applications & Limitations of MRP.
10. Management of Just in Time Manufacturing Systems – Prerequesites for successful JIT systems. Slashing setup Time. Facility layout and organization suitable for JIT Systems.
11. Flexible Manufacturing Systems and Computer Integrated Manufacturing.
12. Management Information Systems.

Termwork :

1. Seminar based on the published papers.
2. Assignments
3. One Case Study.

Text book references :

1. Integrated Production control system, Management , Analysis David D. Bedworth & James E. Baily.
2. Production & Operations Management. : Everett E. Adam J. & Ronald J. Ebert.
3. Manufacturing Planning & Control System : Vollmann T.E. Berry & D. C. Whybark.
4. Operations Management – J.O. Mc Clain & T. L. Joseph.
5. Production & Operations Management : Total Quality & responsiveness.
   : H. Noori & R. Radford
6. Theory & problems in Production and Operations Management : R. N. Chary.

2.02 Advanced Material Joining & Sheet Metal Processing

Theory : 4 periods
Practical / Term Work : 2 periods
Marks : Theory : 100
Termwork : 50

Sheet Metal Processing :

Production and application of sheet metal. Control of properties.

Formability testing of sheet metal.

Power presses : Types, Major components, Selection sheering, slitting and cutting of flat sheet.

Blanking & Piercing with press working tools. Design of dies and the die components.

Design of progressive dies and the die components. Design of the progressive blanking dies. Strip layout. Compound dies. Bending and forming dies.

Bending and Forming dies.

Drawing dies. Die design, Single & Double action dies. Blank development.

Hydroforming , Rubber pad forming , Explosive forming, Bending & Forming of tubes.

Material Joining :

Joining by adhesives. Soldering & Brazing processes.

Fundamentals of fusion welding. Solid state welding. Cold welding, Diffusion welding, Coextrusion welding, Ultrasonic welding, Friction welding , Explosion welding, Electron Beam welding, Laser Beam welding, Eutectic repair welding, Joining in Surface Mount Technology. Automation in welding.

Material joining requirements in VLSI technology.

Term Work :

1. Seminar on published papers
2. Assignments based on press tool design & metal joining (minimum four)
3. One case study on the design of dies.

Text books / References :

1. J.A. Waller, Press Tools and Presswork, Porttucullis press, 1978
2. W. Johnson & P. B. Mellor, Engineering Plasticity, Van Nostrand Reinhold, 1973.
3. C. W. Hinman, Press Working of Metals, McGraw Hill , 1950.
4. Paul Schubeut, Die methods Book One & Two., Industrial Press, 1996.
5. Metal Handbook (10 th Edition) Vol 15 on Metal Forming, 1989.

6. Die Design Handbook, ASM publication, 1989 Edition.
7. Rossi, Welding Engineering.
8. A.W.S. Welding Engineers Handbook, Vol I to IV.
9. Metals Handbook, Welding & Soldering.
10. R. L. Little, Welding & Welding Technology.
11. R. F. Tylecote, Solid Phase Welding Metals
12. ASTME, Tool and Manufacturing Engineers Handbook
13. Nikolaev and Olshansky, Advanced Welding Processes, MIR Publishers.
14. N. Lashko and S. Lashko, Brazing & Soldering of Metals.
15. Uddin , Funk and Wulf, Welding of Engineers.
16. S. M. Sze, VLSI Technology.

3.01: Automation & Control

Theory : 4 periods
Practical / Term Work : 2 periods
Marks : Theory : 100
Termwork : 50

A. Introduction :

- Automation in production Systems.
- Automation Principles & Strategies
- Basic elements of an Automated system.
- Advanced Automation functions
- Levels of Automation

B. High Volume Production Systems

- Transfer Line machines & Automated flow lines
- Analysis of automated flow lines
- Automated assembly systems.
- Automated material handling

C. Mechanical automation

- Cams, Geneva mechanisms, Gears, etc.

D. Low Cost Automation using Pneumatics :

- Characteristics of pneumatic control
- Elements used in Pneumatic automation
- Design of pneumatic circuits for single and multi cylinder actuation for Industrial applications.
- Advantages of Electropneumatics v/s Pneumatic control.
- Design of electropneumatic circuits for industrial applications
- Limitations of Pneumatic & Electropneumatic Control

E. Automation with Hydraulic power control

- Advantages of hydraulic fluid power
- Components used in hydraulic & electrohydraulic circuits
- Design of circuits using hydraulic fluid power for industrial applications and electrohydraulic circuits.

F. Switching Logic gates using AND, NOT, OR gates. Application of NAND, NOR, logic gates. Representation of Industrial automation using standard logic gates as well as NAND & NOR gates.

G . Programmable Logic Control (PLC)

- Ladder logic diagram
- Components of PLC
- Programming the PLC through
- Computer type languages
- For Sequential Functional diagram
- Programmable ladder diagram

H . CNC machining and Programming through Word address format using the following Techniques.

- Programming Aids
- Canned Cycles
- Subroutine methods
- Parameter programming

APT programme for machining operations.

I . Robots applications :

- Characteristics, Robot cell design, Robot Applications (Material handling ,
- Processing operations, Assembly & Inspection.)

J . Engineering Systems and Control Concepts

- Classification of Control Systems
- Continuous Automatic control Systems
- Examples of automatic Control systems
- Derivations of Systems equations.
  Simultaneous equation method
  Block diagram method.
- Response characteristics of components and systems
  Classical solution
  Laplace transform solution
  Response by analog computer
- Frequency response analysis
  Frequency response characteristics
  Effect of Numeral and Zero factors
  Logarithmic representations – Bode diagram and determination of system stability.
- Stability of components and systems
  Roots of the characteristics equation
  Stability from Time response
  Routh Criterion of stability
  Nyquist criterion of stability
- Root locus method of analysis
  Open loop transfer function
  Pole zero concept
  Criteria used for Rapid plotting of Root locus
- Introduction of nonlinear and state variable method of analysis

K. Future Automated factory :

- Trends in manufacturing
- Human workers in the future automated factory
- The Social impact

TERM WORK :

1. Design of circuits (Pneumatic , Hydraulic, Electropneumatic, Electrohydraulic, Hydropneumatic.) for Industrial applications for Automation Assignments on Numerical problems.
2. Design of PLC for industrial applications
3. CNC Programming for Turning & machining centers using Programming aids, canned cycles, Subroutine & Parameter methods.
4. Case studies in mechanical Automation.
5. Literature Survey on emerging trends in automation and seminars on the selected topics.

TEXT BOOKS & REFERENCES :

1. Automation, Production Systems, and Computer Integrated Manufacturing, Mikell P. Groover, Prentice hall of India Pvt. Ltd., 1992
2. Automation, production Systems, and Computer Integrated Manufacturing, Second Edition, Mikell P. Groover, Pearson Education Asia, Delhi, 2001. 3. Engineering Systems and Automatic Control, Peter Dransfield, Prentice hall of India Pvt. Ltd, New Delhi, 1974.
4. Control of Fluid Power, Pippenger & Pace , prentice Hall, 1978.
5. Control System technology, C. J. Chesmond, ELBS, 1982.
6. Computer Numerical Control of Machine tools, S.G. Thyer
7. Computer Numerical Control of Machine tools, Child
8. Robotics and Manufacturing, C. Ray Asfal, John Wiley & Sons, 1985.
9. Festo Didactic,1978
   i) Introduction to Pneumatics
   ii) Fundamentals of Control Engineering applied to Pneumatics
   iii) Electropneumatics
   iv) Simple Memory & Logic Circuits.
   v) Basic & advanced Levels – programmable Logic Control.
   vi) Electrohydraulics.
10. Automated Assembly, G.Boothroyd, Corradopoli, Lawrence E. Murch , Marcel Deckker Inc., 1982.

3.02 : Quality Management

Theory : 4 Periods
Termwork: 2 periods
Marks : Theory : 100
Termwork : 50

1. Historical developments in the Quality Management terminologies – Quality, Quality of Design, Quality of Conformance, Relevance & Importance for World Class manufacturing. – Indian Context – TQM – The supply Chain – Customer orientation.
2. Incoming materials control. Acceptance sampling, Sampling Plans, selection of sampling plan for specified Producer Risk & Consumer Risk and for specific AOQ Double sampling, Sequential sampling. Vendor Development.
3. Process evaluation & control. Control chart, Assignable & Unassignable causes of variation., Control Limit Theorem, X- R chart, p, np chart & c charts. Control limits & specification limits- process capability.
4. Systematic procedures for QEM, Quality Function Deployment, FMEA, Robust design, Fault Tree Analysis, Pareto's curve, Design of Experiments.
5. Quality management – Quality Planning , Cost of Quality, Cost of control,Cost of Failure, Appraisal & Prevention, Organisation for Quality, Quality Circles, Quality & Productivity, Training & Education, Action Plan.
6. Total Quality management. Concept of TQM. Customer Orientation, Supplier Orientation, Process Standardisation, People Orientation, Leadership – Commitment, Total Quality Awareness, Continuous Improvement : KAIZEN, Pokayoke , Zero defect Manufacturing. Total Productive Maintenance (TPM). The 5'S principles.
7. Quality Systems Standards. ISO 9000 concerns & Issues, ISO 14000, QS 9000 Quality System Documentation.
8. Models for organizational Excellence, Indian Award, European Award, Deming Award, MBNQA , Quality awards at the National level.
9. Computer aided In Process Inspection, Computer Applications in Quality Management.
10. The Six Sigma approach for Quality and Productivity Improvement. CTQ, DMAIC process.

TERMWORK :

1. Assignments
2. Seminar based on published papers.
3. Case Studies.
4. Exercises on Computer applications in SQC and Six Sigma.

Text & References :

1. Quality Planning & Analysis : J. M. Juran & F. M. Grayna
2. TQM : D. H. Besterfield
3. Japanese Manufacturing Techniques : R. J. Schonberger
4. Kaizen : Masaki Imai
5. Management of Quality From Deming to Taguchi : Logothetis
6. Leadership as Quality : Juran
7. Industrial Statistics & Quality Control : A. J. Duncan
8. Total Quality Control : Feigenbaum
9. Design & analysis of Experiments : D. C. Montgomery.

4.01 : CAD /CAM /CIM

Theory : 4 Periods
Term Work : 2 Periods
Marks : Theory : 100
Term Work : 50

A. Introduction

CAD / CAM Centres & Tools
History of CAD/CAM Development
Definition of CAD/ CAM Tools.
Utilization of CAD/CAM Systems in an industrial environment.

B. CAD/CAM Hardware

Types of Systems – Mainframe based systems
Mini Computer based systems
Microcomputer based systems
Workstation based systems
Input & Output services.
Hardware integration and networking.

C. CAD/CAM Software

Graphic standards
Database Management Systems
Modes of Graphics operations
Two Dimensional & Three Dimensional Transformations
(Scaling/ Shearing/ Rotation & Reflections)
Mathematics of Projections
Clipping, Hidden Surface Removal
General features of Microcomputer based CAD/ CAM.

D. Geometric Modeling

Wire frame models
Parametric representations of Analytic & Synthetic curves
Surface Models
Parametric representations of Analytic & Synthetic surfaces.
Solid Models
Solid modeling based applications.

E. Visual Realism

Hidden Line Removal
Hidden Surface Removal
Shading
Coloring

F. Finite Element Modeling & Analysis

Finite Element Analysis
Isoparametric Evaluation of Element Matrices
Finite Element Modeling
Mesh Parameters
Design & Engineering Applications

G. Introduction to Computer Numerical Control

CNC Hardware Basics & Tooling
CNC machine Tools & Control Systems
CNC programming (APT, Word address)
Advanced Part programming Methods
Computer Aide Part Programming
Tool Path Generation & verification
Generation of Tool paths , verification of Tool paths.
Role of Intergrative Manufacturing in CAD/ CAM integration
Cellular manufacturing : JIT manufacturing Philosophy, Integration of CAD/CAM for MRP.
Computer Integrated manufacturing – Technology issues
Fundamentals of networking & analysis
Developing successful CAM strategy
Automatic Inspection System
FMS flexible machine lines
FMS layout design
Computerised Process Planning

TERM WORK :

1. CAD Software for product modeling
2. Wire frame & Solid modeling for industrial products, Parametric modeling techniques.
3. Simulation application for computerized machinery.
4. FEA Analysis (2D & 3 D : using software like Ansys , Nastran, etc)
5. Literature survey & seminar presentation on emerging trends in CAD/ CAM implementation.

TEXT BOOKS / REFERENCES :

1. CAD/CAM Theory and practices : by Ibrahim Zeid , Tata McGraw –Hill Publishing Company Ltd, New Delhi
2. CAD/CAM Principles & Applications : by P.N.Rao, Tata McGraw Hill Publishing Company Ltd., New Delhi.
3. Mathematical Elements for Computer Graphics : by David F. Rogers & J. Alan Adams, McGraw Hill Publishing Company.
4. CAD/ CAM Computer Aided Design & Manufacturing : by Michell P. Groover and E. W. Zimmers, Prentice Hall 1992
5. Computer Integrated Manufacturing : by Ranky P.G., Prentice Hall, 1986
6. Computer Integrated Design & Manufacturing : by David B. Bedworth, March R. Handerson, Philip M. Wolphe.

4.02 : PROCESS PLANNING & TOOLING

Theory : 4 periods
Termwork : 2 periods
Marks : Theory : 100
Termwork : 50

1. Introduction to manufacturing processes – The place of process planning in the manufacturing cycle- Organisation chart – Product Engineering – Process Engineering – the Economic impact of modern process Engineering. . Approaches to the process planning.
2. Preliminary part Print analysis. Logical Design of a Process plan. Interpretation of technical drawings. Dimensional analysis. Tolerance Analysis. Tolerancing for manufacturability.
3. Tolerance Charts – Purpose & Utilisation of Tolerance Charts – Structure & Set up Of the Tolerance Chart. Arithmetic rules for Tolerance charts. Balanced or Resultant dimensions. Layout of the Tolerance charts. Developing the Tolerance chart.

   Balancing the Tolerance chart.
4. Workpiece Control – Concepts & practice – Classifying operations. Selection & Planning the process of manufacturing. Determining the Manufacturing sequence.
5. Application of single & multipoint tools in metal cutting process. Development of toolings for production. Economic considerations in Jigs & Fixtures design.

   Software for tooling design.
6. Manual process planning. Case studies of Process Engineering. Shortcomings of traditional process planning. Computer aided process planning. Computer aided measurement systems.
7. SPC : Statistical process Control. Integration of SPC activities in Process Planning. FMEA applied to Process Engineering. Emerging technologies in manufacturing.

TERM WORK :

1. Preliminary Analysis for an industrial component manufacturing.
2. Preparation of Tolerance Chart for the manufacturing of a part
3. Design of Tooling layouts for manufacturing such as Turret lathe, Single & Multispindle Automate.
4. Detailed process planning for the Manufacturing of the Industrial components for batch & mass production.
5. Computerised process design : case studies.
6. Literature collection & presentation for the latest development in process planning & tooling techniques through Process planning.

TEXT & REFERENCES :

1. Modern Manufacturing Process Planning : by Benjamin W. Niebel, Alan B. Draper, Richard A. Wysk, Mc Graw Hill, 1988.
2. An Introduction to Automated Process Planning Systems : by Chary T.C. and Wysk R.A., Prentice Hall, 1984.
3. Computer Aided process Planning : by Allen D. K. & Smith P. R. CAM Lab , Provo, Utah,1980.
4. Principles of Process Planning - A Logical approach : by Halevi G. & Weill R.D., Chapman & Hall, 1985.
5. Process Engineering for Manufacturing : Donald F. Eary, Gerald E.Johnson , Prentice Hall Inc.

5.01 Economic Analysis : Manufacturing Strategies

Theory : 4 periods
Term work : 2 Periods
Marks : Theory : 100
Termwork :50

1. Strategic Planning : Strategies for growth – Survival : Product selection, Core competencies, capabilities. Organisational fit, Derivative / Platform Projects.
2. Strategies for Manufacturing Competitiveness / World Class Manufacturing. Technology, Quality, Speed in delivery – Dependability, Flexibility, Technology Management.
3. System features to achieve Global competitiveness, Agile manufacturing, Life cycle Management, JIT, ERP, Supply Chain Management, Concurrent Engineering, Robust Design, Business Process Reengineering, Theory of Constraints, Synchronous manufacturing.
4. Fixed Cost v/s Variable Cost, Marginal cost, Incremental cost for make or Buy decision. Breakeven analysis for choice between processes. Elements of cost. Overhead cost, Machine hour cost computation, NC Economics.
5. Quantitative techniques : LPP for product mix decision. Sensitivity / Post optimality analysis. Transportation & Assignment models. Queuing models. Dynamic / multistage decisions. Simulations.
6. Investment Analysis , DCF. NPV method. IRR. Payback period. Ratio Analysis : ROI, Turnover ratios.

TERMWORK :

1. One seminar based on the published papers.
2. Case Studies
3. Assignments

Text & References :

1. Manufacturing Strategy, Strategic Management of the Manufacturing functions : Hill Terry
2. Managerial Economics : Dean Joel
3. Operations Research : H. A. Taha
4. New Production System : Isao Shinohara
5. JIT manufacturing : M. G. Korgaonkar
6. Easternisation : The spread of Japanese management Techniques to Developing Countries. : R. Kaplinsky & A. Posthuma.

5.02(1)ENTREPRENEURSHIP & PROJECT MANAGEMENT (ELECTIVE I)

Theory : 4 periods
Termwork : 2 periods
Marks : Theory : 100
Termwork : 50

1. Environment Scanning & Enterprise Selection, Business Perspective, Market Analysis, Risk Analysis, SWOT Analysis, Product Design, Product Selection and Capacity decisions.
2. Technical Analysis , Technology Selection, Impact on environment, Territory & location decisions, Technical feasibility study – Assessment Raw material requirement, Assessment of plant & machinery requirement , Make or Buy Decision, Manpower Requirement Planning, Organisation.
3. Financial Analysis Assessment of Investment Requirement. Working Capital requirements, sources of Finance , Equity versus Debt, Role of Financial institutions, Pricing Decision, Break Even Analysis. Preparation of projected Profit & Loss Account and balance sheet.
4. Legal issues, Government & local body regulations, Small scale Industries, making applications for funds from financial institutions and banks. Government Concessions, Investment allowance , Tax holiday, Tax concessions, State Industrial Development Corporation – and its role.
5. Project management using PERT/ CPM Resource Levelling, Project Cost Control, Cost overrun and its implications on profitability.
6. Investment Analysis. Payback Period, Net Present Value Method, Internal Rate of Return.
7. Business & Commercial Practices.

TERM WORK :

1. Prepation of a project feasibility report
2. Four assignments based on the syllabus.

TEXT BOOKS /REFERENCES :

1. Project Management- Planning & Appraisal – Prasanna Chandra
2. Project Management using PERT and CPM – Wiest & Levy
3. Innovation and Entrepreneurship in Organisation – R. M. Burton
4. Entrepreneurship Development Programme in India : V. G. Patel
5. Entrepreneurial management : R. R. Khan

5.02(2) PRODUCT DESIGN (Elective I)

Theory : 4 Periods
Practical / TermWork : 2 Periods
Marks : Theory : 100
Practical / Termwork : 50

1. Introduction to basic elements and studies in form Concept of line, texture, colour, form, balance, proportions, size, shape, mass, Spatial relationship and compositions in 2 and 3 dimensional space, radii manipulation and form transition. Graphic composition and layout. Use of grids in graphic – composition

   Exploration and study of formal elements to develop visual awareness, imagination and creative insight. Form elements in the context of product design, modular concepts in design. Introduction to colour and colour as an element in design. Colour classification and dimensions of colour, hue, value and chroma relationships, colour dynamics and interaction of colours. Psychological use of colours.

2. **Product design procedure :**

   Market research, product planning and product positioning, understanding of problem areas and limitations. User group and their cultural, physical and psychological background. Need based origin of a product, and technology driven products, Analysis of ideas from various angles of design methodology to fit it to the user. Analysis of function, component process study through computer simulation, building, reliability into the product.

   2D presentation, rendering, sketches of concept drawings and computer generated images, 3D presentations in the form of dummy and prototypes.

3. **Material science and product detailing**

   Usage of materials like thermoplastic and thermoset plastics. F.R.P. and its applications and properties. Injection moulding – compression moulding, blow moulding, extrusion, vacuum forming and F.R. P. forming.

   Machining of plastics and component designs. Snap fits, gluing, welding, inserts in moulding, painting, screen printing of plastics and metals. Design for manufacture using methods of jigs and fixtures, productivity , serviceability, disposal and safety aspects of design.

4. **Applied Ergonomics in product design**

   Gross human autonomy, anthropometry, Environmental conditions including thermal, illusion, noise & vibration controls and displays, Psycho and physiological aspects of design.

5. **Design for production**

   Process consideration in Design, Design of cast members, welded parts, Designing parts to be machined, designing for easy assembly, convenience of maintenance and operation and safety. Tolerance system, standardization. Preferred number series.

6. **Analysis and organization of control panel & displays in product design.**

   Functions and controls, Display elements, dials, knobs, buttons, handles, and electronics displays, investigation of the study of visual, functional & Ergonomical requirements of controls and display elements. Study of product graphics and textures.

7. **Product presentation :**

   Visual communication skills related to product and services. Typeface, layouts, illustrations, sketches for leaflets and instructions. Exploded views for service manuals and catalogues. Forms in nature. Generation of product forms with analogies from nature.

8. **Role of creativity in problem solving**

   Vertical and lateral thinking, Brainstorming, Synectics, Group working dynamics. Monitoring changing scenario in economics, social, cultural and technological fields. Anticipation of new needs and aspirations.

TERM WORK:

1. One 3D modeling on colour balance and radii manipulation.
2. One assignment on understanding 'design procedure' and documenting and interpreting data.
3. One assignment on product detailing on moulding or on F. R. P. forging or on vacuum forming or on jigs & fixture design for manufacturability or on productivity & serviceability.
4. One assignment on principles of Ergonomics & control panel and display using 3D modelling.
5. Redesign of an existing product emphasizing on relative thinking to solve Identified present problem with 3D modeling.

TEXT BOOKS/ REFERNCES :

1. R.G.Scott, Design fundamentals, Mcgraw Hill, 1951
2. Jomes, Design methods inter science, 1970
3. Buhl H. R., Creative Engg. Design, Iowa State University press, 1960
4. Hill Percy H. The Science of Engineering Design, Holt , Rinchart & Winston Inc.1970
5. Ergonomics by Merilyn Joyce, Ulrika Waller Steiner, South Western Publishing Co., 1983
6. Human factors in engineering & design, 4th edition , New Delhi, Tata Mc Graw Hill, 1976
7. Human Engineering Guide & Equipment design, New York, McGraw Hill, 1963 by Morgon C. T. & Others.
8. Barron D. ed, Creativity, New York, Art Directors, 1978
9. Design for production – Baldwin E. W. & Niebel B. W. Edwin, Homewood Illinois, 1975.

5.02(3) PLASTIC ENGINEERING (ELECTIVE I)

Theory : 4 periods
Termwork : 2 periods
Marks : Theory : 100
Termwork : 50

1. General introduction to plastics, their methods of processing and applications, Contribution and comparative performance of plastics in various sectors of business and economy.
2. Principles of Compression, Transfer & Injection moulding. Positive and open flash moulds. Detailed design of the moulds. General construction, ejection systems, feed systems, cooling systems. Moulding of parts with side cores and splits, internal undercuts and threads. Multi daylight & runnerless moulds.
3. Defects in moulding, causes and remedies. Principles of product design, methods of mould manufacture and mould design for ease of construction.
4. Introduction to computer aided design of moulds, case studies and practical design assignments.

TERM WORK :

1. Design and drawing of three moulds/dies.
2. Case study in computer aided design of mould.
3. seminar report on the related topics.

TEXT BOOKS / REFERENCES :

1. Pye, Injection mould Design, George Godwin, Longman, 1983
2. J.H. Dubis and W.L. Prible , Plastic mould Engineering, Reinhold, 1965
3. A. B. Glavil and E. N. Deutron, Injection mould Design Fundamentals, Industrial press Inc. New York.
4. Gaston, Injection Moulds, Hanser Publishers, 1983.
5. L. Sors, Plastic Mould Engineering, Pergamon, 1967.
6. J.A./ Bradson, Plastic Materials, Butterworth, 1980.
7. Design with Plastics and Components, A handbook , Donald V. Rosato, David P. Dimattia, Dominick V. Rosato, 1991, VNR – New York
8. Computer Aided Engineering for Injection moulding : Ernest C, Bernhardt, 1983, Hanser Publishers.
9. Gastrow Injection Moulds, K. Stockherrt, 1983, Hanser Publishers
10. Plastic Blow Moulding handbook, Norman Lee, 1990, VNR- New York.
11. Injection & Compression Moulding Fundamentals, Avra ans I. Isayev, 1987, Marcel Dekkar, New York.

5.02 (4) MATERIAL FORMING TECHNOLOGY (Elective I)

	Lecture	: 4 hours
	Termwork	: 2 hours
	Theory : 3 hours	: 100 Marks
	Termwork	: 50 Marks
Objective		To study and analyze Shape Forming Processes in Manufacturing Engineering.
Approach	:	Emphasis on understanding of basic Principles through schematized Approach and problem solving at fundamental level.
Weightage	:	Equal weightage to all chapters.

1. THEORY OF PLASTIC (Permanent) DEFORMATION:

A. Plastic Stresses:
Stress Tensor, Hydrostatic Stress Tensor and Stress Deviator Tensor. Maximum Shear Stress, Principal Stresses and Principal Directions, Plane Stress Condition.

B. Plastic Strains:
Normal Strain, Shear Strain, Strain Tensor, Hydrostatic Strain Tensor and Strain Deviator Tensor.
Principal Strains, Strain Rates and Principal Strain Rates, Plane Strain Condition.

C. Yield Criteria:
Tresca's Yield Criterion and Von Mises Yield Criterion.
Levy –Mises' Equations.

2. METALLIC MATERIALS FORMING PROCESSES:

A. Review of Fundamental Casting Processes:
Sand Casting, Gravity Die Casting, Pressure Die Casting, Investment Casting and Continuous Casting Processes.

B. Developments in Casting Processes:
Rheo-Casting, Thixo-Casting and Compo-Casting Processes. Squeeze-Casting – Theoretical Background, Process Outline, Advantages and Limitations.

C. Developments in Forming Processes:
Thermo-mechanical Processing and Significance.
Roll Forging, HERF, Ring Rolling, Rotary Swaging, Radial Forging, Powder Forging, Orbital Forging and Coining. Hydrostatic Extrusion, Cold Heading and Cold Extrusion. Flat, Bar and Shape Rolling. Spinning, Roll Forming, Explosive Forming and Electro Magnetic Forming.
Superplastic Forming.

3. **PLASTICS FORMING PROCESSES:**

A. **Forming Processes:**
Compression Moulding, Transfer Moulding, Injection Molulding, Extrusion, Blow Moulding, Calendering, Spinning of Fibres and Thermoforming.

B. **Casting Processes:**
Plastisol Casting with Variations such as Dip Casting, Slush Casting and Rotational Casting.

C. **Plastics Foaming Processes and Powder Moulding Processes.**

4. **CERAMICS FORMING PROCESSES:**

A. **Raw Materials Processing :**
Raw Materials and Raw Materials Selection Criteria.
Powder Preparation and Sizing.
Preconsolidation.

B. **Shape Forming Processes :**
Pressing – Uniaxial, Isostatic, Hot Pressing and Hot Isostatic Pressing. Slip-Casting – Drain, Solid, Vacuum, Pressure, Centrifugal, and Fugitive Wax Casting. Tape Casting – Doctor Blade, Waterfall and Paper-Casting. Plastic Forming – Extrusion, Roll Forming, Injection Moulding and Compression Moulding.

C. **Miscellaneous Processes :**
Green Machining and Densification Processes.

5. **COMPOSITES FORMING PROCESSES:**

A. **Metal Matrix Composites :**
Diffusion Bonding, Powder Metallurgy, LPPD, Melt Stirring, Rheo-Casting/Compo-Casting, Squeeze Casting, Liquid Melt Infiltration and Extrusion-Drawing.

B. **Polymer Matrix Composites:**
Hand Lay-up and Spray-up Methods, Matched Metal Moulding Methods, Bag Moulding Methods, Pultrusion and Filament Winding.

C. **Ceramic Matrix Composites:**
Slurry-Infiltration:, Melt Infiltration, CVD and CVI processes.

6. **EVALUATION OF WORKABILITY**

A. Material Factors.

B. Process Variables.

C. Workability Fracture Criteria.

D. Dynamic Material Modelling.

TERM WORK:

The termwork will comprise of at least four assignments on theory and ten problems based on the above syllabus and one seminar report based on actual presentation of related advanced topics and current literature survey.

REFERENCES:

THEORY OF PLASTIC (Permanent) DEFORMATION:

1. Principles Of Metal Working by Surender Kumar (Oxford & IBH Publishing Co. Pvt. Ltd.)
2. Plasticity Theory and its Application in Metal Forming by V. Gopinathan (Wiley Eastern Limited)
3. Metal Forming: Processes and Analysis by Betzalel Avitzur (Tata MaGraw-Hill Publishing Co. Ltd.)

METALLIC MATERIALS FORMING PROCESSES:

4. Manufacturing Technology by P.N. Rao (Tata McGraw-Hill Publishing Co. Ltd.)
5. Die Casting by H.H. Doehler (McGraw Hill Book Company, Inc.)
6. Fundamentals of Tool Design by ASTME (Prentice-Hall of India Private Ltd.)
7. Metals Hand Book – Volume 15 (Casting) by ASM (ASM-International).
8. Investment Casting by H.T. Bidwell (The Machinery Publishing Co. Ltd.)
9. High Velocity Forming of Metals by ASTME (Prentice-Hall of India Pvt. Ltd.)
10. Metals Hand Book – Volume 14 by ASM (ASM-International)

PLASTICS FORMING PROCESSES:

11. Plastics Engineering by R.J. Crawford (Butterworth-Heinemann)
12. Plastics Technology Handbook by Manas Chanda and Salil K. Roy (Marcel Dekker, Inc.)
13. Plastic Engineering Handbook, SPJ by Joel Frados (Van Nostrand Reinhold, New York)
14. Moulding of Plastics by N.M. Bikales (ed.) (Interscience, New York).
15. Plastisols and Organosols by H.A. Sarvetnick (ed.) (Van Nostrand Reinhold, New York)

CERAMICS FORMING PROCESSES:

16. Principles of Ceramic Processing by J.S. Reed (Wiley, New York)
17. Treatise on Material Science and Technology, Ceramic Fabrication Processes, Vol.9 by J.C. Williams (F.F.Y. Wang, ed.) (Academic Press, New York).
18. Modern Ceramic Engineering by David W. Richerson (Marcel Dekker, Inc.)
19. Introduction to Ceramics by W.D. Kingery, H.K. Bowen, and D.R. Uhlmann (Wiley-Interscience, New York)
20. Advanced Ceramics by Chemical Vapour Deposition Techniques by D.P. Stinton, T.M. Besmann and R.A. Lowden, Am. Ceram. Soc. Bull 67 (2), 350-355.

COMPOSITES FORMING PROCESSES:

21. Composite Materials Science and Engineering by Krishan K. Chawla (Springer-Verlag)
22. Reinforced Thermoplastics by Titows, W.V. and Lanham, B.J. (Applied Science Publisher).
23. Advances in Processing of Continuous Fibre Reinforced Composites by Meng Hou, Lin Ye and Yiu-Wing Mai, Plastics, Rubber and Composites Proc. And Appl., 23, 5 (1995) pp. 279-292.
24. Tool and Manufacturing Engineers Handbook, Vol. 8 by Mitchell, P. (ed.), Soc. Man. Eng., Michagan.
25. Handbook of Composites by G. Lubin (ed.), (Van Nostrand Reinhold, New York).
26. Preparation of Lanxide™ Ceramic Matrix Composites: Matrix Formation by the directed Oxidation of Molten Metals, by M.S. Newkirk et. Al., Ceram. Eng. And Sci. Proc. 8(7-8), 879-885.

EVALUATION OF WORKABILITY

27. Metals Hand Book – Volume 14 by ASM (ASM-International)

6.01: SEMINAR ON SPECIAL TOPICS

Termwork : 4 periods
Marks : 50

Seminar topic should be related to the syllabus mentioned above. The literature collection should be from published journals. While selecting Seminar topic, emphasis should be given to emerging fields.

6.02: DISSERTATION SEMINAR

Term work
Marks : 50

Candidates will have to take up a project in any manufacturing Engineering area either I any industry or in an educational institution having the necessary facilities.

A report on the project and work including literature survey, formulation of the problem and scope of the work, theoretical / experimental should be submitted as term work. The same will have to be presented as a Seminar. The assessment of the work will be done by the guide and an external examiner.

7.01 : PRESYNOPSIS DISSERTATION SEMINAR

Term work
Marks : 50

Candidate on completion of the project shall submit a synopsis of the work done. – Methodology, experimental results, analysis and conclusion and also present a Seminar. The same will be assessed by the guide and the departmental head and on acceptance of the same, the candidate can prepare the final Project Report.

7.02 DISSRTATION AND VIVA-VOCE

Termwork
Marks : 100
Oral : 100

The final Project Report typed and bound submitted by the candidate will be sent to the University and University will appoint two examiners, one internal & one external and the assessment will be done jointly.
