

**Scheme of Teaching and Examination for
6 th Semester of 3 Years Diploma in Metallurgy Engineering.**

Duration of Semester : 14 Weeks

Student Contact Hours : 36 Hrs

Total Marks : 800

Effective from : 2017 -18 Session

Sl. No.	Name of Subject	Subject Code	Subject	Teaching Scheme			Examination Scheme					
				L	T	P	Hours of Exam	Full Marks of Subject	Final Exam / committee marks	Internal Assessment	Pass Marks Final / Ext. Exam	Pass Marks in Subjects
1.	Management & Entrepreneurship	601	Theory	3		-	3	100	80	20	26	40
2.	Advance Foundry Technology	MET 604	Theory	3	-	-	3	100	80	20	26	40
3.	Manufacturing Process	MET 605	Theory	3	-	-	3	100	80	20	26	40
4.	Fuel Refectory & Furnaces	MET 606	Theory	3	-	-	3	100	80	20	26	40
5.	Elective II	MET 607/608/609	Theory	3	-	-	3	100	80	20	26	40
6.	Foundry Lab	MET 610	Practical	-	-	2	-	50	40	10	20	20
7.	Manufacturing Process Lab	MET 611	Practical	-	-	2	-	50	40	10	20	20
8.	Fuel Refectory & Furnaces Lab	MET 612	Practical	-	-	2	-	50	40	10	20	20
9.	Elective II Lab	MET 613/614/615	Practical	-	-	2	-	50	40	10	20	20
10	Project Work	603	Sessional	-	-	4	-	50	30	20	-	25
11	Professional Practices	602	Sessional	-	-	4	-	50	30	20	-	25
Total Hours of Teaching per week :				15		16						

Elective II (Welding Technology- MET-607/ Alloy Steel -MET 608/Nano Structured Materials -MET 609)

Total Marks : Theory : Practical : Sessional :
L : Lecture, T : Tutorial P : Practical

- Note:
1. Period of Class hours should be of 1 hrs duration as per AICTE norms.
 2. Remaining Hrs every week has been marked for students for Library and Student Centered Activities.
 3. Drawing / Graphics / Practical / Sessional examinations will be held at parent institution.
 4. Board will depute examiner for Practical examination.
 5. Regarding sessional examination the parent institution will form a three member committee and this committee will examine the sessional records and hold viva of the examinee for 60 % marks allotted to the subject. Marks for remaining 40 % will be provided by the Faculty concerned on the basis of evaluation of each job / work throughout the semester.

Subject : Industrial Engineering & Management

Subject Code : 601

Full Marks : 80+20= 100

L	T	P
3	0	0

Rationale :

After completion of three years of technical training, Polytechnic students are expected to enter in to the World of Work. The business environment is altogether different and new to the students. A proper introduction and understanding of Business Processes is therefore essential for all Polytechnic students. Management is a subject which deals with basics of Management science required to understand the processes the in Industrial & Commercial environment. This will enable the students of Polytechnic to become familiar and to understand various Business Organizational structures, their functioning and the Role these technicians will have to play in these setups with responsibilities.

Industrial Engineering is concerned with the design, improvement and installation of integrated systems of people, materials, equipment and energy. Polytechnic students must be able to analyze the use and cost of the resources of the organization in order to achieve the objective, i.e. to increase productivity, profits etc. and carryout the policies efficiently and effectively.

Objective :

The students will able to :

1. Familiarize environment in the world of work.
2. Explain the importance of management process in Business.
3. Identify various components of management.
4. Describe Role & Responsibilities of a Technician in an Organizational Structure.
5. Apply various rules and regulations concerned with Business & Social responsibilities of the technician.

Detailed Syllabus

1. **Productivity :** **02**
Production and productivity, importance of productivity, factors affecting productivity, means of increasing productivity.

2. **Plant Layout and Material Handling :** **02**
Definition of plant layout, objectives of good plant layout, principles of plant layout, types of plant layout, flow pattern, steps in planning the layout for a new enterprise, definition of material handling, functions and principles of material handling, material handling devices.

3. **Work Study :** **04**
Definition, concept and need for work study, objectives of method study and work measurement, basic procedure/steps in method study, recording technique, critical examination, principles of motion economy, stop watch procedure for collecting time study data, including performance rating and allowances, work sampling.

4. **Production Planning and Control (PPC) :** **04**
Definition and objectives of PPC, functions of PPC, routing, scheduling, loading, dispatching, production control definition and objectives, principle of sound production control system.

5. **Material, Purchase and Stores Management :** **04**
Definition, functions& objectives of materials management, inventory control, economic order quantity (EOQ), ABC analysis. Objectives of purchasing department, buying techniques, purchasing procedure (steps involved in one complete purchasing cycle); functions of stores department, location and layout of stores, receipt and issue of materials.

6. **Quality Control and TQM :** **04**
Meaning of quality and quality control, dimensions of quality, quality circle, concept and definition of TQM, elements of TQM, Kaizen, 5 'S' and six sigma.

7. **Management :** **04**
Various definition, concept of management, levels of management, administration and management, scientific management by F. W. Taylor. Principles of management (14 principles of Henry Fayol). Functions of management - planning, organizing, coordinating, directing, controlling, decision making.

8. **Organizational Management :**

04

Organization - definition, steps in forming organization. Types of organization. Types of organization - line, line and staff, functions, project type. Departmentation- Organized and decentralized, authority and responsibility, span of control (management). Forms of ownership - proprietorship, partnership, joint stock company, co-operative society, govt. sector.

9. **Human Resource Management :**

06

Personnel Management – Introduction, definition, function. Staffing – Introduction to HR, Introduction to HR Planning, Recruitment procedure. Personnel- Training & Development – Types of training, Induction, Skill enhancement. Leadership & Motivation – Leadership- Styles & types, Motivation- Definition, Intrinsic, &Extrinsic, Moslow’s theory of Motivation and its significance. Safety Management – Causes of accident, Safety Procedures. Introduction, Objectives & feature of Industrial Legislation such as – Factory act, ESI act, Workman compensation act, Industrial dispute act and salary & wages.

10. **Financial Management :**

04

Financial Management- Objectives & Functions. Capital Generation & Management- Types of capitals, Sources of finance. Budgets and accounts- Types of budgets, Production budget (including variance report), Labour budget, Introduction to Profit & Loss Accounts (Only concept), Balance sheet etc.

11. **Entrepreneurship :**

04

Concept and definition of entrepreneur and entrepreneurship, factors influencing entrepreneurship, entrepreneurial characteristics, need for promotion of entrepreneurship and small scale industries, steps in setting up a small scale industrial enterprise.

References Books :

1. Industrial Engineering and Management by O. P. Khanna
2. Industrial Engineering and Production Management by M. Mahajan.
Publisher :Dhanpat Rai Publication (P) Ltd. New Delhi
3. Business Administration and Management by Dr. S. C. Saksena
Publisher :Sahitya Bhawan, Agra.

Subject : **Advance Foundry Technology**
Subject Code : **MET604**
Hours : **42**
Full Marks : **80+20 = 100**

Theory Content

- 1 Introduction to foundry, casting production. Sand & Non-sand Casting processes, Special Casting processes-Full mold, Shell molding, CO₂, Die, Investment, Centrifugal etc. Sand molding materials, their properties, selection & testing (Grading of sand, GCS, DCS, Permeability etc) Bonding & bond mechanisms (Clay-water, Hydraulic & Organic), 8 hrs
- 2 Selection of Foundry Clay (Bentonite Structure, Base Exchange capacity & Acceptability Test.). Additives, Mechanization of Sand molding Process, Patterns-Allowances, Types, Selection etc. 4 hrs
- 3 Gating Design, Laws of fluid flow, Top & Gating Time, Aspiration correction, Design of gating for a plate casting. Riser Design (Modulus method, Geometry of risers, Directional solidification, Chill, Padding etc.) Complete Methoding Practice from Pattern to riser/gating design of individual castings. 8 hrs
- 4 Solidification of -Metals, Alloys & Eutectics, (Nucleation & Growth Process, Critical nucleus size, Super cooling, G/R ratio, Cell, Dendritic & Random dendritic structure, Segregation & Coring, Eutectics, Compositions in Cast Irons, FG & SG structures, Metallic Glass) . Mold dilation, Mold-metal reactions. Structure & Section sensitivity 8 hrs
- 5 Cast irons-family & microstructures, Alloying effects, Cupola & its operation, nodular iron and alloy cast irons. White (Malleable) Iron, ADI, Charge calculations. 6 hrs
- 6 Non-ferrous casting production (Silumin alloys, Liquid forging, Brass & Bronze casting) 4 hrs
- 7 Melting furnaces (Arc, Induction, Gas & Oil fired furnaces, Fluxes). Fettling & finishing, Casting defects-Hot tears, Inclusions and porosities. NDT testing & inspection, Casting design 4 hrs

Subject : **Advance Foundry Technology Lab**
Subject Code : **MET610**

1. Sand Testing: Grading of Sand for foundry purpose,
2. Determination of Optimum moisture content in Green Sand Practice
3. Determination of DCS of Core Sand,
4. Determination of Permeability for molding sand mixtures,
5. Sand Molding Practice for production of molds (Cope & Drag Pattern),
6. Core-making Practice,
7. Study of different types of Pattern.
8. Gating Design Calculations,
9. Riser Design by Modulus method,
10. Melting of metals & Production of Castings using sand molds/metal molds.
11. Identification of Casting Defects & Cast-metal Structures.

Books

1. Principles of Metal Casting - Heine and Rosentall
2. Foundry Technology - Beelay
3. Foundry Technology - M.Lal
4. Foundry Technology - P.L.Jain
5. Foundry Technology - Goel and Sinha

Subject : **Manufacturing Process**
Subject Code : **MET605**
Full Marks : **80+20=100**
Hours : **42**

1) Metal Cutting

Basic Elements Of Machining, Types Of Metal Cutting, Classifications Of Cutting Tools, Single Point Tools, Geometry Of Single Point Cutting Tools, Cutting Fluids, Types Of Cutting Fluids, Selection Of Cutting Tools

2) Lathe Mechine And Metal Turning

Introduction To Lathe, Types Of Lathe, Standard Specification Of Lathe, Types Of Turning, Threading Operations On Lathe, Lathe Accessories And Attachments.

3) Shaping Machine

Elements Of Shaping Machine, Shaper Mechanism, Adjustment Of Stroke Length, Horizontal Shaping Machine And Its Specification, Main Parts Of Horizontal Shaper.

4) Planning And Slotting Machine

Types Of Planning Machine, Main Parts, Machine Operations, Feed Mechanism, Slotting Machine, Operation On Slotting Meets

5) Milling Machine

Types Of Milling Mechine, Principle Of Working, Types Of Milling Operations, Milling Operations, Helical Milling.

6) Grinding Machine

Types Of Grinding Mechine, Main Parts, Boring Tools, Boring Heads

Subject : Manufacturing Process Lab

Subject Code : MET611

List of Experiments

1. Metal cutting tools
2. Metal cutting process
3. Metal cutting and machining
4. Cutting fluids
5. Shaping of irregular metals
6. Study of lathe machine
7. Threading and milling operation on lathe
8. Slotting of metal piece
9. Grinding machine operation and grinding
10. Planning machine operation and tools operation.

Books-

Textbook of Manufacturing Technology by R K Rajput

Manufacturing Process by SEROPE K

Manufacturing Process by J K Khuswant

Joining Processes by M G NI cholas

Subject : **Fuel Refectory and Furnaces**
Subject Code : **MET606**
Hours : **42**
Full Marks : **80+20 = 100**

CONTENT-

1. Various forms of energy including non-conventional source. Solar energy, Wind energy, Tidal energy & Bio-mass and their applications in different fields. 3 Hrs
2. Definition of Fuel and its importance. Indian coals washing methods. 2 Hrs
3. Coking coal, Testing of of coking properties, carbonisation of coal. 2 Hrs
4. Coke ovens, Recovery of by-products, industrial carbonization. 2 Hrs
5. Classification, Classification and composition of gases, Classification of coal, Manufacturing of producer gas, Water gas, Carburetted water gas and Blast furnace gas, Catalytic process & hydrogenation. 4 Hrs
6. Natural gas, cracking and reforming of natural gas, use of natural gas in Metallurgy. Laser and its applications. 3 Hrs
7. Classification and uses of furnaces in metallurgy based on technology, structure and heat generation. 3 Hrs
8. Fundamentals of heat engineering of furnaces. Heat transfer laws, Review of steady state, conduction. 3 Hrs
9. Transient conduction, cartesian, cylindrical and spherical co-ordinates, solution for simple geometry and boundry conditions. 3 Hrs
10. Convective heat transfer and radiative heat transfer. 2 Hrs
11. Flow of gases in furnaces, ducts, drafts, chimney. Sample calculations, waste heat recovery, regenerators and recuperators, principle and design, Blast furnace stove. 3 Hrs
12. Elements of furnace design, Refractories, materials for constructions, Fuel burning devices for solid/liquid/gaseous fuel, design of roof and hearth. 3 Hrs
13. Principle of electric heating, Resistance heating elements, principles of induction heating, core and coreless furnaces, various types, comparison, Typical calculations. 3 Hrs
14. Study of few important metallurgical furnaces, Special furnaces, Plasma heating, Optical furnaces, Uses of laser. 3 Hrs
15. Temperature Measurement and control, calculations on heat transfer and fluid flow. Simple furnace design. 3 Hrs

Subject : **Fuel Refectory and Furnaces Lab**
Subject Code : **MET612**

List of Experiments

1. Calorific value of coal
2. Calorific value gas
3. Calorific value of liquid fuels
4. Ash content of fuels
5. Study of properties of rectorories
6. Study of furnaces
7. Thermal behavior of refractory
8. Use of refractory in furnishes
9. Electric and resistance heating
10. Liddell preparation for steel casting

TEXT/REFERENCE:

1. Combustion Engineering, A.K. Shaha, Oxford and IBH Publ. Co. Calcutta,1974 and Fuel Technology
2. Metallurgical Furnaces, V.K Krivanchiv and B.Markov, MIR Publ. Moscow, 1977.
3. Metallurgical Engineering, Schuman Principles Vol 1
4. The General Theory of M.A. Glinkov and G.M. Glinkov, MIR Publ.Moscow,1978
Furnace

Subject : Welding Technology (Elective-II)
Subject Code : MET607
Hours : 42
Full Marks : 80 + 20 =100

Introduction-

1. History, Importance of Metal Joining Processes: Theory of Metal joining, barriers of welding, classification of welding processes. 4 hrs
2. Fusion welding: Joint design and edge preparation, methods and selection, nature of heat sources, physics of arc, electrical characteristic of arc, machine characteristics. 4 hrs
3. Metal transfer, forces acting on the arc, different modes of metal transfer, heat flow in metals, prediction of heating and cooling rates. 4 hrs
4. Gas-metal and slag-metal reactions, evolution of gases, formation of porosity, inclusions in weld metal, weld pool solidification, residual stresses, weld cracking, solidous and sub-solidous, dilution. 4 hrs
5. Fusion welding: SMAW – ‘unction of coatings, based on slag metal, gas metal reactions, classification of coating types, formulation of continuous welding by coated electrodes, SAW, electrosag welding. 4 hrs
6. GTAW, GMAW, FCAW, Plasma Welding, type of guns. 2 hrs
7. Electron beam welding: Laser beam welding, gas welding, cutting methods. Solid phase welding, cold pressure welding, hot pressure welding, friction welding, explosive welding, ultrasonic and diffusion welding. 4 hrs
8. Resistance welding: Contact resistance, spot, seam projection, resistance butt, flash butt etc. Soldering and brazing, theory, types of alloy systems, methods of heating type of joints, adhesive joining. 6 hrs
9. Weldability of carbon and low allow steels. Hydrogen embrittlement, Brittle fracture, weldability of stainless steels, weldability tests, weldability of non-ferrous systems. 4 hrs
10. Quality control in welding, procedure for control of material, establishment of correct welding procedure, qualification of operators, testing and inspection during and after welding. Welding defects. 6 hrs

Subject : Welding Technology Lab (Elective-II)
Subject Code : MET613

LABORATORY WORK:

1. Study of Gas welding flame and gas welding methods.
2. Practical on Electric arc welding.
3. Practical on Spot welding.
4. Practical on Seam welding.
5. Practical on TIG, MIG and SAW welding.
6. Study of furnaces for stress relieving, annealing, normalizing, preheating and post heating.
7. Study of Microstructure of weldment.
8. Plasma welding
9. Electron Beam Welding
10. Removal of dirt/slag from weld surfaces
11. Calculation and comparison of hardness/ strength of weld joint and adjoining area.

TEXT / REFERENCES:

1. The Metallurgy of Welding, Brazing and Soldering – J.F. Lancaster, George Alien and Unwin Ltd., London.
2. Introduction to Welding and Brazing – D.R. Milner & R.L. Apps. Pergamon Press, London.

Subject : Alloy Steel
Subject Code : MET608
Hours : 42
Full marks : 80 +20 = 100

Theory content

Different type of Alloying elements, their effect on properties of alloy, ferros and non ferros alloys, Stainless steels, tool steel , transformer grade steel, High speed steel, spring steel, forging grade steel. 10 hrs

Description of Non Ferrous Alloys : Copper Zinc alloys, Copper Tin alloys, Aluminum Copper Alloy, bearing metals, soldering metals, and their applications 8 hrs

Alloy steel making processes –special reference to stainless steels, high speed steel, manganese steel and other special steels, 6 hrs

Thermodynamics and kinetics of alloy steel making, Defects & remedies, Post solidification treatments, Secondary alloy steel making technologies. Problems. 6 hrs

Basics of ferro alloys production –concepts, thermodynamic principles & techniques, Existing production process of important ferro alloys , Fe-Cr, Fe-Mn, Fe-Si, Recent advances in ferro alloy technology, 6 hrs

Production of other ferro alloys –Fe-V, Fe-Ti, Fe-W, Fe-Nb, Fe-Mo, Fe-Ni, Fe-Zr, Fe-B etc 6 hrs

Subject : Alloy Steel Lab
Subject Code : MET614

List of Experiments-

1. Properties of alloying elements
2. Effects of Alloying elements
3. Micro alloying of steel
4. Study of high strength low alloy(HS LA)
5. Study of carbon content in steel
6. Polishing of steel surfaces
7. Cutting ability of high speed steel
8. Study of corrosion attack on stainless steel
9. Self lubricating property of bearing metals
10. Aging of Aluminum Copper alloy

Books

Physical Metallurgy by V Ragwan
Elements of Metallurgy by Swroop and Sexsena
Metallurgy for Engineers by Rollason
Physical Metallurgy by Avamar

Subject : Nano Structured Materials (Elective-II)
Subject Code : MET609
Full Marks : 80+20 =100
Hours : 42

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INTRODUCTION

- 1) NANO STRUCTURAL MATERIALS, DEFINITION, BASIC CONCEPTS MICROSTRUCTURE AND SOURCE OF NANO STRUCTURAL MATERIALS 8 hrs
- 2) CONSTITUENT OF NANO STRUCTURAL MATERIAL, CLASSIFICATION, SPECIALTY, DIFFERENCE FROM OTHER GENERAL ENGG MATERIAL 8 hrs
- 3) EFFECTS OF TEMP ON NEO STRUCTURAL MATERILS, CHEMICAL BINDING, EFFECTS ON PROPERTIES, STABILITY OF NsM AGAINST GRAIN GROWTH. 8 hrs
- 4) APPLICATION OF NsM, ADVANTAGES AND OCCURRENCE RECENT DEVELOPMENT IN THE FIELD OF NANO STRUCTURE MATERIALS 8 hrs
- 5) SYNTHESIS OF NANO STRUCTURE MATERIALS, DEVELOPMENT IN PRODUCTION OF NsM IN INDIA, IMPORTANT CHARECTERISTICS, SCOPE OF DEVELOPMENT OF NsM 10 hrs

Subject : Nano Structured Materials Lab (Elective-II)
Subject Code : MET615

List of Practical's:-

- 1) Analysis of grapheme using Raman spectroscopy.
- 2) Study of nano particles by thermal Decomposition.
- 3) Surface Plasmon resonance study of silver nano particles.
- 4) Synthesis of Ag-PANI nano composite.
- 5) Study on Dye sensitized solar cell.
- 6) Study of isolation of Pyramid.
- 7) Study on characteristics of LED and Photo Diode.
- 8) Synthesis of NiO thin film of gas sensing applications.

Books-

Nano Structural Material by Carl C Koch
Nano Structural Material by Gerhard Wilde
Nano Structural Material by Hari Singh Nalwa

Subject : Professional Practices (Common Paper)

Subject Code : 602

Rationale:

Most of the diploma holders join industries. Due to globalization and competition in the industrial and service sectors the selection for the job is based on campus interviews or competitive tests.

While selecting candidates a normal practice adopted is to see general confidence, ability to communicate and attitude, in addition to basic technological concepts.

The purpose of introducing professional practices is to provide opportunity to students to undergo activities which will enable them to develop confidence. Industrial visits, expert lectures, seminars on technical topics and group discussion are planned in a semester so that there will be increased participation of students in learning process.

Activities to be undertaken:

Students are expected to undertake these activities:

1. Acquire information from different sources (Print and electronic) on the topics of specialization and related to the subjects of II nd and final year. The class is to be divided in groups of not more than five to six students in a group and all groups are to be allotted topic of their choice. The topic should not be repeated to other group for originality of work to be performed by the group. This activity will develop interdependence and leadership among the students.
2. Prepare notes for given topic at point no 1. The notes will be in form of a project report, having all the sections of report. The report should not be of 30 – 50 pages.
3. Prepare presentation and Present the learning and finding on given topic in a seminar. The presentation should be prepared in Power Point module having more than 25 slides. All students should be asked to deal with suitable parts decided by the group itself.
4. Interact with peers to share thoughts. After the final presentation the students should be encouraged to interact with the faculty members, students' fellows and other experts for suggestions and advanced and structured learning.
5. Undertake industrial visit of their area and choice. Prepare a report on industrial visit. Expert lectures on the topic selected may be invited for the students and these expert lectures also the students should be asked to prepare a report and present the same in seminar or have a group discussion before the expert and faculty members.
6. Develop entrepreneurial traits. Students group may be asked to have a field survey and product assessment and analysis for a product of their choice. Prepare a report for all the inputs of their requirement and submit it for evaluation.
7. To prepare for start ups. Expert lectures for exploring this option may be arranged as this is also a viable option and much talked about option for self employment and avail the encouragement by the government.

Based on the above rationales students will advised to develop traits under guidance of dedicated faculty members / mentors.