

METALLURGICAL ENGINEERING

DETAILED SYLLABUS FOR PART – 2 (2nd. YEAR) : FOURTH SEMESTER

WEST BENGAL STATE COUNCIL OF TECHNICAL EDUCATION											
TEACHING AND EXAMINATION SCHEME FOR DIPLOMA IN ENGINEERING COURSES											
DURATION OF COURSE : 6 SEMESTERS											
SEMESTER : FOURTH											
BRANCH : METALLURGICAL ENGINEERING											
SR. NO.	SUBJECT	CREDITS	PERIODS			EVALUATION SCHEME					
			L	TU	PR	INTERNAL SCHEME			ESE	PR	Total Marks
						TA	CT	Total			
1	IRON MAKING PROCESS	4	3	-	1	10	20	30	70	50	150
2	PHYSICAL METALLURGY	4	3	-	3	10	20	30	70	100	200
3	METAL WORKING	4	3	-	2	10	20	30	70	50	150
4	FUEL, FURNACE & REFRACTORY	3	3	-	2	10	20	30	70	50	150
5	ELECTRICAL ENGINEERING	3	2	-	2	5	10	15	35	50	100
6	COMPUTER PROGRAMMING	3	1	-	2	-	-	-	-	50	50
7	DEVELOPMENT OF LIFE SKILL – II	2	1	-	2	-	-	-	-	50	50
8	PROFESSIONAL PRACTICE - II	2	1	-	2	-	-	-	-	50	50
Total :		25	17	-	16	45	90	135	315	500	900
STUDENT CONTACT HOURS PER WEEK: 33 hrs ; DURATION : 15 WEEKS / SEMESTER											
Theory and Practical Period of 60 Minutes each.											
L- Lecture, TU- Tutorials, PR- Practical, TA- Teachers Assessment, CT- Class Test, ESE- End Semester Exam.											

IRON MAKING PROCESS

Subject Code MET / S4 / T1 / IMP	Course offered in Part – II , 4 th . Semester	Course Duration 15 weeks	3 lecture contact periods (@ 60 Minutes) per week	Full Marks 70
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OBJECTIVE

1. a) Discuss the occurrence & distribution of iron ores .
b) State the raw material used for iron making .
2. a) Understand about operation of Blast furnace & its accessories .
b) State the factors affecting the composition of pig iron .
c) State the common operating troubles in blast furnace , causes & remedies .
3. a) State the composition of pig iron .
b) State the constituents ,characteristics & uses of slag .
c) Discuss about blast furnace by-product , treatment & uses .
4. Understand the different alternative route of iron making process .

MODULAR DIVISION OF THE SYLLABUS

GROUP	MODULE	TOPIC	CONTACT PERIODS
A	1	Introduction, Raw Materials for Iron Making .	10
	2	Agglomeration of iron ore .	10
B	3	Iron Blast furnace & its operation .	10
	4	Modern developments in BF iron making	5
C	5	Alternative route of Iron production .	10
			TOTAL PERIODS: 45

EXAMINATION SCHEME

Group	Chapter	Objective Question				Subjective Question			
		No. of questions to be set	No of questions to be answered	Marks for each question	Total Marks	No. of questions to be set	No of questions to be answered	Marks for each questions	Total marks
A	1, 2,.	9	8	1	8	5	4	5	20
B	3 , 4.	9	8	1	8	5	4	5	20
C	5.	5	4	1	4	3	2	5	10
		23	20		20	13	10		50

Reference Books :-

1. Modern Iron Making --- Dr. R.H.Tupkary .
2. Manufacture of Iron & steel , Iron Production – Vol – I ,II & III --- G.R.Bashforth.
3. Making Shaping & Treating of Steel --- United States Steel .
4. Physical Chemistry of Iron & Steel making --- R.G.Ward .
5. Iron & Steel industry in India --- M.R.Chaudhuri .

DETAIL COURSE CONTENT

GROUP - A

1.0 Introduction, Raw Materials for Iron Making . 10 PERIODS

- 1.1 Introduction to iron and steel making; role of iron making in integrated steel plant .
- 1.2 Brief geometrical idea and their location.
- 1.3 Indian iron ores ,quality of iron ores of different zones .
- 1.4 Beneficiation of iron ores .
- 1.5 Raw materials for iron making and their preparation.
- 1.6 Metallurgical coke – important properties required.

2.0 Agglomeration of iron ore . 10 PERIODS

- 2.1 Justification of agglomeration, comparison of quality between ore and agglomerate
- 2.2 Various techniques – Sintering, Pelletization, briquetting etc
- 2.3 Brief description of Sintering process; role of variables
- 2.4 Brief description of pelletization process; important properties of agglomerates .

GROUP - B

3.0 Iron Blast furnace & its operation . 10 PERIODS

- 3.1 Description of blast furnace and its accessories , refractory lining and cooling . stoves; gas cleaning system. hot blast.
- 3.2 Burden distribution and their effects. bell-less top charging methods
- 3.3 Physical chemistry of the reactions at various zones, slag formation, sulphur and silicon reactions
- 3.4 Calculation of blast furnace charges.
- 3.5 Factors affecting blast furnace productivity; alumina problem in India
- 3.6 Some common operating troubles in blast furnace and their causes and remedies.
- 3.7 External treatments of hot metal – desulphurization, desilicization
- 3.8 Utilization of BF products – gas and slag

4.0 Modern developments in BF iron making 5 PERIODS

- 4.1 Importance of reducing coke rate
- 4.2 Injection of solid and liquid through tuyeres – injection of coal, oil , plastic granules etc
- 4.3 Oxygen-enriched blast & its limitations, increase of blast temperature
- 4.4 High top pressure operation of blast furnace
- 4.5 Factors affecting blast furnace productivity; environmental aspects of iron making

GROUP - C

10 PERIODS

5.0 Alternative route of Iron production .

- 5.1 Limitations of blast furnace route, other options for iron production
- 5.2 Mini blast furnace –characteristics; difference with conventional iron blast furnace
- 5.3 Electro – Thermal Smelting Process -- basic principle , operation & effectiveness .
- 5.4 Direct Reduced Iron (Sponge Iron) Technology - outline of important gas-based and coal- based processes, physical chemistry of the reactions; uses of sponge Iron ; Indian scenario .
- 5.5 Smelting Reduction (SR) technology – ITMK3 , FINEX / COREX - basic principle , operation & effectiveness .

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Subject Code MET / S4 / P1 / IMP	Course offered in Part – II , 4 th . Semester	Course Duration 15 weeks	2 Practical contact periods (@ 60 Minutes) per week	Full Marks 50
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PRACTICAL : LABORATORY EXPERIMENTS :

SL. No.	NAME OF EXPERIMENT
1.0	Chart on Iron ore deposit : Chart in a table form of iron deposit, and their utilization mentioning user, annual requirement, quality, yearly import & export .
2.0	Chart on metallurgical coal deposit
2.1	Chart in a table form the Metallurgical coal deposit in India with quality, type and amount of reserve.
2.2	Draw the chart of Indian Standard Specification for Blast furnace coke and their properties.
3.0	Flow chart on sinter plant .
3.1	Draw the schematic arrangement & flow chart of a sinter plant .
4.0	Flow chart & diagram of blast furnace operation .
4.1	Draw the schematic diagram of Iron Blast furnace.
4.2	Draw the flow diagram of blast furnace operation .
4.3	Make a chart of typical pig iron composition for different grade.

EXAMINATION SCHEME

1. Continuous Internal Assessment of 25 marks is to be carried out by the teachers throughout the 4th. Semester.
2. Distribution of marks : Performance of Job – 15, Notebook – 10.
3. External Assessment of 25 marks shall be held at the end of the Third Semester on the entire syllabus.
4. Distribution of marks for External Assessment : On spot job – 10, Viva-voce – 15

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PHYSICAL METALLURGY

Subject Code MET / S4 / T 2 / PM	Course offered in Part – II , 4 TH . Semester	Course Duration 15 weeks	3 lecture contact periods @ 60 Minutes per week	Full Marks 70
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OBJECTIVE

1. Understand the meaning of solidification of metals.
2. Understand about the formation of different phases in Iron Carbon equilibrium diagram.
3. Understand about the heat treatment of metals.
4. Gather concept about TTT & CCT diagram, their utility & importance .
5. Understand about Hardenability & its determination process .

MODULAR DIVISION OF THE SYLLABUS

GROUP	MODULE	TOPIC	CONTACT PERIODS
A	1	Phases in Iron - Carbon equilibrium diagram.	7
	2	Solidification of Metals & Alloys.	8
B	3	T-T-T & CCT Diagram .	8
	4	Heat treatment of Steel.	12
C	5	Hardenability	10
			TOTAL PERIODS: 45

EXAMINATION SCHEME

Group	Chapter	Objective Question				Subjective Question			
		No. of questions to be set	No of questions to be answered	Marks for each question	Total Marks	No. of questions to be set	No of questions to be answered	Marks for each questions	Total marks
A	1,2.	9	ANY 20	1	20	5	4	5	20
B	3,4.	9				5	4	5	20
C	5.	5				3	2	5	10

Reference Books :-

1. Engineering Physical Metallurgy --- Y. Lakhtin .
2. Introduction to Physical Metallurgy --- S.H.Avner .
3. Physical Metallurgy Principles --- Reed Hill .
4. Metallurgy for Engineers --- E.C. Rollason .
5. Physical Metallurgy for engineers --- Clark & Varney .
6. Journal "Metal News" – Published by The Indian Institute of Metals .
7. The physical metallurgy of steels --- Leslie .
8. Elements of physical metallurgy – A.G.Guy .

DETAIL COURSE CONTENT

GROUP A	15 PERIODS
1.0 Alloy System & Phase transformation in Iron - Carbon equilibrium diagram.	7 PERIODS
1.1 Alloy System , Classification of alloys, Interstitial, substitutional, Intermetallic compounds.	
1.2 Hume -Rothery rules of alloying;	
1.3 Types of Solid Solution with example .	
1.3 Different phases & their transformation mechanism in Iron - Carbon equilibrium diagram – Brief outline .	
2.0 Solidification of Metals & Alloys.	8 PERIODS
2.1 Liquid Phase & Phase rule.	
2.2 Nucleation.	
2.3 Crystal growth from liquid phase.	
2.4 Dendritic growth.	
2.5 Freezing of Ingots.	
2.6 Cast structure.	
2.7 Segregating.	
2.8 Homogenization.	
2.9 Inverse segregation.	
3.0 Porosity problems.	
GROUP B	20 PERIODS
3.0 T-T-T & CCT Diagram .	8 PERIODS
3.1 T-T-T curve & its description.	
3.2 Effect of temperature on pearlite formation.	
3.3 C-C-T diagram.	
3.4 Difference between T-T-T & C-C-T diagram .	
3.5 Critical cooling rate to produce martensite	
3.6 Formation of bainite	
4.0 Heat treatment of Steel.	12 PERIODS
4.1 Definition & objectives of heat treatment.	
4.2 Annealing	
4.3 Normalising	
4.4 Hardening.	
4.5 Tempering.	
4.6 Sub-Zero treatment.	
4.7 Defects due to heat treatment.	
GROUP C	10 PERIODS
5.0 Hardenability	10 PERIODS
5.1 Definition & concept .	
5.2 Determination of hardenability by Grossman method , merits & demerits.	
5.3 Determination of hardenability by Jominy method , merits & demerits.	
5.4 Effect of grain size, carbon content, & alloying elements on hardenability.	
5.5 Severity of quench, Ideal quench.	

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Subject Code MET / S4 / P2 / IMP	Course offered in Part – II , 4 th . Semester	Course Duration 15 weeks	3 Practical contact periods (@ 60 Minutes) per week	Full Marks 50
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PRACTICAL : LABORATORY EXPERIMENTS :

Sl. No.	NAME OF EXPERIMENT
1.0	Microstructural study.
1.1	Study of different plain carbon steel under annealed, normalized, hardened & Tempered conditions.
1.2	Study of cast- Iron.
1.3	Study of copper & its alloys
1.4	Study of Aluminium & its alloys.
2.0	Heat treatment.
2.1	Annealing of hypo eutectoid , hyper eutectoid steel , studying microstructures & hardness value.
1.2	Normalising of above samples , studying microstructures & hardness value.
1.3	Analysis of above results & explanation
1.4	Grain size measurement in above samples .
3.0	Determination of Hardenability by Jominy method .
2.1	Sample preparation for hardenability test (Jominy method) .
2.2	Austenitising of hadenability sample.
2.3	Quenching of hadenability sample.
2.4	Plotting graph .
2.5	Explanation of readings.
3.0	Calibration of Thermocouple
3.1	Calibration of thermocouples by primary method .

Requirement of Equipment/Machinery/ Ancillaries :

1. Heattreatment furnace .
2. Metallurgical Microscopes .
3. Abrasive cutting wheel .
4. Abrasive polishing machine .
5. Mounting machine .
6. Polishing papers & abrasives .
7. Jominy hardenability chamber .
8. Thermocouples.

EXAMINATION SCHEME

1. Continuous Internal Assessment of 50 marks is to be carried out by the teachers throughout the 4th. Semester.
2. Distribution of marks : Performance of Job – 35, Notebook – 15.
3. External Assessment of 50 marks shall be held at the end of the Third Semester on the entire syllabus.
4. Distribution of marks for External Assessment : On spot job – 25, Viva-voce – 25 .

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METAL WORKING

Subject Code MET / S 4 / T3 / MW	Course offered in Part – II , 4 TH . Semester	Duration 15 weeks	3 lecture contact periods @ 60 per week	Full Marks 70
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Educational Objectives: After completion of this subject, the students will be able to:-

1. Know about different metal working processes.
2. Understand about details of Rolling process.
3. Understand about different forging processes & defects.
4. Explain about Extrusion Process .
5. Understand about Wire drawing & Deep drawing processes.

MODULAR DIVISION OF THE SYLLABUS

GROUP	MODULE	TOPIC	CONTACT PERIODS
A	1	Introduction to different metal working processes	8
	2	Rolling of metals & Alloys.	8
B	3	Forging process	8
	4	Extrusion Process	8
C	5	Wire drawing	8
	6	Deep drawing	5
			TOTAL PERIODS: 45

MODULAR DIVISION OF THE SYLLABUS & EXAMINATION SCHEME

Group	Chapter	Objective Question				Subjective Question			
		No. of questions to be set	No of questions to be answered	Marks For each question	Total Marks	No. of questions to be set	No of questions to be answered	Marks for each questions	Total marks
A	1, 2,.	8	ANY 20	1	20	5	ANY TEN	5	50
B	3, 4.	8				4			
C	5 ,6.	8				4			

Reference Books :-

1. Engineering Physical Metallurgy --- Y. Lakhtin .
2. Introduction to Physical Metallurgy --- S.H.Avner .
3. Mechanical Metallurgy --- G.E.Dieter .
4. Physical Metallurgy Principles --- Reed Hill .
5. Metallurgy for Engineers --- E.C. Rollason .

DETAIL COURSE CONTENT

1.0 Introduction to different metal working processes.

- 1.1 Importance of hot – metal working.
- 1.2 Temperature in Metal working.
- 1.3 Classification of metal – working.
- 1.4 Thermo -mechanical treatment.

2.0 Rolling of metals & Alloys.

- 2.1 Classification of Rolling-Mills.
- 2.2 Hot- rolling.
- 2.3 Cold-rolling.
- 2.4 Variables in rolling.
- 2.5 Forces in rolling.
- 2.6 Defects in rolling.

3.0 Forging Process .

- 3.1 Forgability – Forging .
- 3.2 Open-die Forging.
- 3.3 Closed die Forging.
- 3.4 Press & Hammer forging.
- 3.5 Hot- stamping.
- 3.6 Defects in forging.

4.0 Extrusion Process

- 4.1 Types of Extrusion.
- 4.2 Application & Limitation of extrusion.
- 4.3 Variables in extrusion.
- 4.4 Seamless tube production.
- 4.5 Defects in extrusion.

5.0 Wire - drawing.

- 5.1 Wire-drawing techniques.
- 5.2 Wire-drawing die.
- 5.3 Half-die angle, Patenting .
- 5.4 Defects in wire drawing.

6.0 Deep – drawing .

- 6.1 Re-drawing.
- 6.2 Deep-drawn products.
- 6.3 Drawability
- 6.4 Defects in deep Drawing.

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Subject Code MET / S 4 / P3 / MW	Course offered in Part – II , 4 TH . Semester	Duration 15 weeks	2 Practical contact periods @ 60 per week	Full Marks 50
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PRACTICAL : LABORATORY EXPERIMENTS :

SL. No.	NAME OF EXPERIMENT
1	Flow chart & design on Rolling mill .
1.1	Flow chart of a rolling mill .
1.2	Diagram of various types of rolling mill .
1.3	Roll – pass design .
2.0	Drawings & design on Forging
2.1	Diagram of forging hammers .
2.2	Diagram of forging press .
2.3	Forging Die – design
3.0	Drawing on Extrusion .
3.1	Diagram of extrusion machine .
3.2	Diagram for extrusion of tubes .
3.3	Die – setting in extrusion
4.0	Sketching on Draw bench & Die design
4.1	Sketch of draw bench
4.2	Drawing – die design
4.3	Sketch of multiple – pass drawing head .

REQUIREMENT OF EQUIPMENT/MACHINERY/ ANCILLARIES :

1. Standard colour chart on Rolling mill .
2. Standard drawing on Forging equipments .
3. Standard drawing on Extrusion .
4. Standard drawing on Draw bench & Dies .

EXAMINATION SCHEME

1. Continuous Internal Assessment of 25 marks is to be carried out by the teachers throughout the 4TH. Semester.
2. Distribution of marks : Performance of Job – 15, Notebook – 10.
3. External Assessment of 25 marks shall be held at the end of the Third Semester on the entire syllabus.
4. Distribution of marks for External Assessment : On spot job – 15, Viva-voce – 10 .

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FUEL, FURNACE & REFRACTORY

Subject Code MET / S 4 / T4 / FFR	Course offered in Part II 4 TH . Semester	Course Duration 15 weeks	3 lecture contact periods (@ 60 Minutes) per week	Full Marks 70
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OBJECTIVE

Upon successful completion of this course the students will be able to: —

1. Understand the classification, properties, applications of solid fuels;
2. Understand the classification, properties, applications of liquid fuels;
3. Understand the classification, properties, applications of gaseous fuels;
4. Know about different furnaces, processes & applications;
5. Know & explain about utility, application & properties of different refractory.

MODULAR DIVISION OF THE SYLLABUS

GROUP	MODULE	TOPIC	CONTACT PERIODS
A	1	INTRODUCTION	2
	2	SOLID FUELS	10
B	3	LIQUID FUELS	8
	4	GASEOUS FUELS	6
C	5	FURNACES	9
	6	REFRACTORY	10
			TOTAL PERIODS: 45

EXAMINATION SCHEME

GROUP	MODULE	OBJECTIVE QUESTIONS				SUBJECTIVE QUESTIONS			
		TO BE SET	TO BE ANSWERED	MARKS PER 1 R QUESTION	TOTAL MARKS	TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS
A	1, 2	5	ANY 20	1	1 x 20 = 20	THREE	TWO	5	10 X 5 = 50
B	3, 4	9				FIVE	FOUR		
C	5, 6	9				FIVE	FOUR		

REFERENCE BOOKS :

1. Refractories – Manufacture, Properties and Applications -- A. Rashid Chesti
2. Fuels & Furnaces - Brame & King
3. Fuels , Furnaces & Refractories -- R.B.Gupta

DETAIL COURSE CONTENT

GROUP – A **12 PERIODS**

1.0 INTRODUCTION **2**
1.1 Importance of fuel, furnace & refractory in metallurgy.

2.0 SOLID FUELS **10**
2.1 Classification of coal and special characteristics of metallurgical coal.
2.2 Coke making and bye-product.
2.3 Testing of coal and coke for metallurgical purpose.

GROUP – B **14 PERIODS**

3.0 LIQUID FUELS **8**
3.1 Important liquid fuels for metallurgical industry.
3.2 Requisite characteristics of liquid fuels.

4.0 GASEOUS FUELS **6**
4.1 Producer gas and water gas.
4.2 Blast furnace gas and coke oven gas.
4.3 Coal gas from coal & gasification process.

GROUP – C **19 PERIODS**

5.0 FURNACES **9**
5.1 Introduction to metallurgical furnaces.
5.2 Types & purpose, characteristics of different furnaces.
5.3 Outline of fuel-fired furnace, Resistance furnace, Arc furnace, Induction Furnace.

6.0 REFRACTORY **10**
6.1 Introduction to refractory.
6.2 Classification and characteristics of metallurgical refractory.
6.3 Refractory testing.
6.4 Refractory used in various metallurgical furnaces.

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Subject Code MET / S 4 / P 4 / FFR	Course offered in Part II 4 TH . Semester	Course Duration 15 weeks	2 Practical contact periods (@ 60 Minutes) per week	Full Marks 50
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PRACTICAL : LABORATORY EXPERIMENTS :

SL. No.	NAME OF EXPERIMENT
1	To determine moisture content in coal
2	To determine volatile matter in coal
3	To determine ash content in coal
4	To determine fixed carbon content in coal
5	To determine total Carbon & Hydrogen in coal
6	DRAWING & LABELLING OF DIFFERENT TYPES OF FURNACES WITH SMALL DESCRIPTIONS
	A. CUPOLA FURNACE
	B. ELECTRIC ARC FURNACE (E.A.F)
	C. CRUCIBLE FURNACE
	D. L.D. Converter
7	Refractory Testing
	A. Pyrometric Cone Equivalent Test (P.C.E.)
	B. Refractoriness under load (R.U.L)
	C. Cold crushing strength (CCS) :
8	Drawing and Labelling of Blast Furnace & its Refractories along with chart

REQUIREMENT OF EQUIPMENT/MACHINERY/ ANCILLARIES :

1. Testing equipments for analysis of coal.
2. Standard colour drawings of different Furnaces.
3. Samples of different refractory & their testing equipments.

EXAMINATION SCHEME

1. Continuous Internal Assessment of 25 marks is to be carried out by the teachers throughout the Fourth Semester.
2. Distribution of marks : Performance of Job – 15, Notebook – 10.
3. External Assessment of 25 marks shall be held at the end of the Fourth Semester on the entire syllabus.
4. Distribution of marks for External Assessment : On spot job – 10 , Viva-voce – 15

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ELECTRICAL ENGINEERING

Subject Code MET / S4 / T5 / EE	Course offered in Part - II , 4 TH . Semester	Course Duration 15 weeks	2 lecture contact periods @ 60 Minutes per week	Full Marks 35
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OBJECTIVE

Metallurgical Engineers while working in industries he have to deal with operation & maintenance of Electrical machines & equipments such as – Generators, motors, transformers, starters. Electrical supply system etc. Therefore, to enable the diploma holders in Metallurgical Engineering to acquire fair knowledge in the above topics the subject “ Electrical Engg.” has been included in the course of studies .

Educational Objectives: After completion of this subject, the students will be able to:-

1. Acquire basic knowledge about construction , principle of operation, characteristics & uses of d.c. generators .
2. Acquire basic knowledge about principle of operation, characteristics & uses of d.c. motors.
3. Acquire basic knowledge about construction & principle of operation of A/C generator, alternator, & 3 phase system.
4. Describe the basic construction and principle of operation of transformers.
5. Describe the construction & principle of operations of 3 phase induction motors and their uses .

MODULAR DIVISION OF THE SYLLABUS

GROUP	MODULE	TOPIC	CONTACT PERIODS
A	1	D.C. GENERATOR	5
	2	D.C . MOTOR	5
B	3	A.C GENERATOR / ALTERNATOR	5
	4	A.C - 3 – PHASE SYSTEM	5
C	5	TRANSFORMER	5
	6	THREE PHASE INDUCTION MOTOR	5

TOTAL PERIODS : 30

EXAMINATION SCHEME

Group	Module	Objective Questions				Subjective Questions			
		To Be Set	To Be Answered	Marks Per Questions	Total Marks	To Be Set	To Be Answered	Marks Per Questions	Total Marks
A	1, 2	4	3	1	10	THREE	TWO	5	5 X 5= 25
B	3, 4	5	4			THREE	TWO		
C	5, 6	4	3			TWO	ONE		

Reference Books :-

1. A text book of Electrical Technology Vol-I & II , B.L. Thereja
2. Basic Electrical Engineering , Nagrath& Kothari .
3. Basic Electrical Engineering , .J.B.Gupta .

DETAIL COURSE CONTENT

GROUP -- A	10 PERIODS.
1.0 D.C. generators	5
1.1 Construction – Main parts, materials they are made of, functions of the parts.	
1.2 Field & armature connection , diagrams and classification of the Generators on the basis of these connections.	
1.3 Deduction of emf equation and simple problems.	
1.4 Application of D.C generators.	
2.0 D.C . Motor	5
2.1 Principle of operation & classification.	
2.2 Back emf ; deduction of expression for torque, simple problems .	
2.3 D.C. Motor starter - classification & necessity .	
2.4 Speed equations and speed control of shunt & series motor- Armature resistance control & field control only.	
2.5 Application of D.C. motors	
GROUP -- B	10 PERIODS.
3.0 A.C Generators / Alternators	5
3.1 Construction – Main parts – Rotor, stator, slip ring and brushes, excitors and their functions.	
3.2 Principle of operation, classification and uses .	
4.0 A.C - 3 – phase systems	5
4.1 Connections – a) Star connection -3 phase, 3 wire and 4 wire systems. b) Delta connection – 3 phase 3 wire systems	
4.2 Relation between line & phase values of voltage & current – in each case and expression for power.	
4.3 Advantages of 3 phase system over single phase system.	
GROUP -- B	10 PERIODS.
5.0 Transformers	5
5.1 Construction & principle of operation of single phase transformers.	
5.2 E.M.F. equation and deduction of the relations --- $N_1 / N_2 = E_1 / E_2 = I_2 / I_1$	
5.3 Connections of 3 phase transformers a) Star / Star b) Delta / Delta c) Star / Delta d) Delta / Star (Connections only)	
5.4 Applications of transformers	
6.0 Three phase Induction motors	5
6.1 Construction, principle of operation and classification (Squirrel cage, slipring motors)	
6.2 Defination and relationship of syn. speed , actual speed slip and frequency of rotor current.	
6.3 Solve simple problems .	

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Subject Code MET / S4 / P5 / EE	Course offered in Part - II , 4 TH . Semester	Course Duration 15 weeks	2 Practical contact periods @ 60 Minutes per week	Full Marks 50
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PRACTICAL : LABORATORY EXPERIMENTS :

Sl. No.	NAME OF EXPERIMENT	PERIODS
1	Study of meggar & its application	2
2	Study of energy meter (induction type) & its application.	2
3	Study of constructional features of 3 phase induction motor.	4
4	Study of star / delta starter for 3 phase induction motor.	4
5	Study auto transformer starter for 3 phase induction motor.	4
6	Study of direct on line starter for 3 phase squirrel cage induction motor.	3
7	Measurement of armature resistance of a d.c. machine.	3
8	Study of the constructional features of a d.c. machine.	4
9	Study of the constructional features of single phase & 3 phase transformers	4

TOTAL = 30 PERIODS

EXAMINATION SCHEME

1. Continuous Internal Assessment of 25 marks is to be carried out by the teachers throughout the Fourth Semester.
2. Distribution of marks : Performance of Job – 15, Notebook – 10.
3. External Assessment of 25 marks shall be held at the end of the Fourth Semester on the entire syllabus.
4. Distribution of marks for External Assessment : On spot job – 15 , Viva-voce – 10

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COMPUTER PROGRAMMING

Subject Code MET / S4 / P6 / CP	Course offered in Part - II , 4 TH . Semester	Course Duration 15 weeks	1 Theory & 2 Practical contact periods @ 60 Minutes per week	Full Marks 50
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Objective

Students should be able to :

1. Break a given task into subtasks.
2. Enhance logical thinking.
3. Develop 'C' programs for simple applications.
4. Prepare and interpret flow chart of a given problem.
5. Represent data in various forms.
6. Use various control statements and functions
7. Run and debug 'C' program successfully.

REFERENCE BOOKS :

1. Introduction to 'C' programming - Byron Gotfried - Tata McGraw Hill
2. Let us 'C' - Yashwant Kanitkar -- BPB publications
3. Introduction to 'C' programming - Denis Ritchie and Kerninghan - Prantice Hall Publications .
4. Programming in 'C' -- Balguruswamy - Tata Mc- Graw Hill
5. Programming in 'C' -- Jeopovan .

DETAIL COURSE CONTENT

1.0 Introduction

2 PERIODS

- 1.1 Problem, definition and analysis, algorithm, flow charts, tracing and dry running of algorithms.
- 1.2 Introduction to 'C' programming, simple program using Turbo 'C' compiler and execution of 'C' program .

2.0 C Fundamentals

3 PERIODS

- 2.1 Character set , constants & variables , data types, identifiers, key words, variable declarations .
- 2.2 Types of Operators – unary, binary, arithmetic, relational, logical, assignment.
- 2.3 Hierarchy of operators, expressions, library functions, Use of input / output functions viz. Printf (), Scanf (), getch (), putch () .

3.0 Use of Control Statements

4 PERIODS

- 3.1 if-else, while loop, do – while loop, for loop, switch, break and continue.
- 3.2 Writing, Compiling, Executing and debugging programs .
- 3.3 Introduction to Subscripted variables, arrays, defining and declaring one and two dimensional arrays, reading and writing

4.0 Concept of String

3 PERIODS

- 4.1 String input / output functions .
- 4.2 Defining and accessing a user defined functions, Passing of arguments, declaration of function prototypes .
- 4.3 Storage classes: automatic, external, static variables . register .

5.0 Concept of Function

3 PERIODS

- 5.1 Function declaration .
- 5.2 Simple program using function .
- 5.3 Function prototype declaration .

Total = 15 PERIODS

PRACTICAL : LABORATORY EXPERIMENTS :

Full Marks = 50 ; CONTACT PERIODS = 2 Sessional @ 60 Minutes contact periods per week for 15 weeks .

Sl. No.	NAME OF EXPERIMENT	PERIODS
1.0	To write simple program having engineering application involving following statements :	
1.1	Use of Sequential structure	3
1.2	Use of if-else statements , Use of multiple branching Switch statement .	6
1.3	Use of for statement	3
1.4	Use of Do-While Statement.	3
1.5	Use of While statement	3
1.6	Use of break and Continue statement .	3
1.7	Use of different format specifiers using Scanf() and Printf() .	3
1.8	Use of one dimensional array e.g. String, finding standard deviation of a group data.	3
1.9	Use of two dimensional array of integers/ reals .	3

TOTAL = 30 PERIODS

EXAMINATION SCHEME

1. Continuous Internal Assessment of 25 marks is to be carried out by the teachers throughout the Fourth Semester.
2. Distribution of marks : Performance of Job – 15, Notebook – 10.
3. External Assessment of 25 marks shall be held at the end of the Fourth Semester on the entire syllabus.
4. Distribution of marks for External Assessment : On spot job – 15 , Viva-voce – 10

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DEVELOPMENT OF LIFE SKILL – II

Subject Code MET / S4 / P7 / DLSII	Course offered in Part - II , 4 TH . Semester	Course Duration 15 weeks	1 Theory & 2 Practical contact periods @ 60 Minutes per week	Full Marks 50
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Objective : students will be able to:

1. Developing working in teams
2. Apply problem solving skills for a given situation
3. Use effective presentation techniques
4. Apply techniques of effective time management
5. Apply task management techniques for given projects
6. Enhance leadership traits
7. Resolve conflict by appropriate method
8. Survive self in today's competitive world
9. Face interview without fear
10. Follow moral and ethics
11. Convince people to avoid frustration

Sl. No.	NAME OF EXPERIMENT	PERIODS
1.0	SOCIAL SKILLS : SOCIETY, SOCIAL STRUCTURE, DEVELOP SYMPATHY AND EMPATHY	1
2.0	Swot Analysis – Concept , How to make use of SWOT	1
3.0	Inter personal Relation : Sources of conflict, Resolution of conflict , Ways to enhance interpersonal relations.	1
4.0	Problem Solving : A . STEPS IN PROBLEM SOLVING . 1) IDENTIFY AND CLARIFY THE PROBLEM . 2) INFORMATION GATHERING RELATED TO PROBLEM . 3) EVALUATE THE EVIDENCE, 4) CONSIDER ALTERNATIVE SOLUTIONS AND THEIR IMPLICATIONS, 5) CHOOSE AND IMPLEMENT THE BEST ALTERNATIVE, 6) REVIEW B . Problem solving technique. (any one technique may be considered) 1) Trial and error, 2) Brain storming, 3) Lateral thinking	2
5.0	Presentation Skills : Body language -- Dress like the audience , Posture, Gestures, Eye contact and facial expression. PRESENTATION SKILL – STAGE FRIGHT, Voice and language – Volume, Pitch, Inflection, Speed, Pause Pronunciation, Articulation, Language, Practice of speech. Use of aids –OHP,LCD projector, white board.	2
6.0	Group discussion and Interview technique – Introduction to group discussion, Ways to carry out group discussion, Parameters— Contact, body language, analytical and logical thinking, decision making . INTERVIEW TECHNIQUE , NECESSITY, TIPS FOR HANDLING COMMON QUESTIONS .	2
7.0	Working in Teams : UNDERSTAND AND WORK WITHIN THE DYNAMICS OF A GROUPS , TIPS TO WORK EFFECTIVELY IN TEAMS, ESTABLISH GOOD RAPPORT, INTEREST WITH OTHERS AND WORK EFFECTIVELY WITH THEM TO MEET COMMON OBJECTIVES, TIPS TO PROVIDE AND ACCEPT FEEDBACK IN A CONSTRUCTIVE AND CONSIDERATE WAY , LEADERSHIP IN TEAMS, HANDLING FRUSTRATIONS IN GROUP.	2
8.0	Task Management : INTRODUCTION , TASK IDENTIFICATION , TASK PLANNING , ORGANIZING AND EXECUTION, CLOSING THE TASK .	2

Total = 13

PRACTICAL : List of Assignment: Any Eight Assignment = 4 Periods Per Assignment X 8 = 32 Periods.

Sl. No.	NAME OF EXPERIMENT	PERIODS
1.	SWOT analysis:- Analyse yourself with respect to your strength and weaknesses, opportunities and threats. Following points will be useful for doing SWOT. a) Your past experiences, b) Achievements, c) Failures, d) Feedback from others etc.	4
2.	Undergo a test on reading skill/memory skill administered by your teacher.	4
3.	Solve the puzzles.	4
4.	Form a group of 5-10 students and do a work for social cause e.g. tree plantation, blood donation, environment protection, camps on awareness like importance of cleanliness in slum area, social activities like giving cloths to poor etc. (One activity per group) .	4
5.	Deliver a seminar for 10-12 minutes using presentation aids on the topic given by your teacher.	4
6.	Watch / listen an informative session on social activities. Make a report on topic of your interest using audio / visual aids. Make a report on the programme. .	4
7.	Conduct an interview of a personality and write a report on it.	4
8.	Discuss a topic in a group and prepare minutes of discussion. Write thorough description of the topic discussed.	4
9.	Arrange an exhibition, displaying flow-charts, posters, paper cutting, photographs etc on the topic given by your teacher.	4

TOTAL = 32 PERIODS

Note : - Please note that these are the suggested assignments on given contents / topic. These assignments are the guide lines to the subject teachers. However the subject teachers are free to design any assignment relevant to the topic. The term work will consist of any eight assignments.

REFERENCE BOOKS :

1. Adams Time management -- Marshall Cooks - Viva Books .
2. Basic Managerial Skills for All -- E.H. Mc Grath , S.J. -- Prentice Hall of India, Pvt Ltd
3. Body Language - Allen Pease - Sudha Publications Pvt. Ltd.
4. Creativity and problem solving - Lowe and Phil Kogan -- Page (1) P Ltd .
5. Decision making & Problem Solving -- Adair, J - Orient Longman .
6. Develop Your Assertiveness -- Bishop , Sue Kogan - Page India .
7. Make Every Minute Count - Marion E Haynes -- Kogan page India
8. Organizational Behavior - Steven L McShane and Mary Ann Glinow - Tata McGraw Hill
9. Organizational Behavior - Stephen P. Robbins-- Prentice Hall of India, Pvt Ltd
10. Presentation Skills - Michael Hatton - (Canada – India Project) ISTE New Delhi .
11. Stress Management Through Yoga and Meditation -- Sterling Publisher Pvt Ltd
12. Target setting and Goal Achievement - Richard Hale ,Peter Whilom - Kogan page India
13. Time management - Chakravarty, Ajanta -- Rupa and Company .
14. Working in Teams - Harding ham - A Orient Longman

INTERNET ASSISTANCE

1. <http://www.mindtools.com>
2. <http://www.stress.org>
3. <http://www.ethics.com>
4. <http://www.coopcomm.org/workbook.htm>
5. <http://www.mapforprofits.org/>
6. <http://www.learningmeditation.com> <http://bbc.co.uk/learning/courses/>
7. <http://eqi.org/>
8. <http://www.abacon.com/commstudies/interpersonal/indisclosure.html>
9. <http://www.mapnp.org/library/ethics/ethxgde.htm>
10. http://www.mapnp.org/library/grp_cnfl/grp_cnfl.htm
11. <http://members.aol.com/nonverbal2/diction1.htm>
12. http://www.thomasarmstron.com/multiple_intelligences.htm
13. <http://snow.utoronto.ca/Learn2/modules.html>
14. <http://www.quickmba.com/strategy/swot/>

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PROFESSIONAL PRACTICE - II

Subject Code	Course offered in	Duration	3 Practical contact periods	Full Marks
MET / S 4 / P 8 / PPII	Part - II 4 TH . Semester	15 weeks	(@ 60 Minutes) per week	50

Objective : The Student will be able to :

1. Acquire information from different sources.
2. Prepare notes for given topic.
3. Present given topic in a seminar.
4. Interact with peers to share thoughts.
5. Prepare a report on industrial visit, expert lecture

1. Structured industrial visits be arranged and report of the same should be submitted by the individual student, to form part of the term work. **8 Periods.**

Two industrial visits may be arranged in the following areas / industries :

- i) Manufacturing organizations for observing various manufacturing processes including heat treatment.
- ii) Material testing laboratories in industries or reputed organizations
- iii) Auto workshop / Garage
- iv) Plastic material processing unit
- v) ST workshop / City transport workshop

2. Lectures by Professional / Industrial Expert / Student Seminars based on information . **8 Periods**
Search to be organized from any three of the following areas :

- i) Use of a plastics in automobiles.
- ii) Nonferrous Metals and alloys for engineering applications
- iii) Surface Treatment Processes like electroplating, powder coating etc.
- iv) Selection of electric motors.
- v) Computer aided drafting.
- vi) Industrial hygiene.
- vii) Composite Materials.
- ix) Heat treatment processes.
- x) Ceramics
- xi) Safety Engineering and Waste elimination

3. Individual Assignments : Any two from the list suggested . **8 Periods**

- i) Process sequence of any two machine components.
- ii) Write material specifications for any two composite jobs.
- iii) Collection of samples of different plastic material or cutting tools with properties , specifications and applications.
- iv) Preparing models using development of surfaces.
- v) Assignments on bending moment , sheer forces , deflection of beams and torsion chapters of strength of material.
- vi) Select different materials with specifications for at least 10 different machine components and list the important material properties desirable.
- vii) Select 5 different carbon steels and alloy steels used in mechanical engineering applications and specify heat treatment processes employed for improving the properties. Also give brief description of the heat treatment processes.
- viii) List the various properties and applications of following materials – a) Ceramics b) Fiber reinforcement plastics ; c) Thermo plastic plastics ; d) Thermo setting plastics ; e) Rubbers.

OR

Conduct ANY ONE of the following activities through active participation of students and write report.

- i) Rally for energy conservation / tree plantation.
- ii) Survey for local social problems such as mal nutrition, unemployment, cleanliness, illiteracy etc.
- iii) Conduct aptitude , general knowledge test , IQ test
- iv) Arrange **any one** training in the following areas : a) Yoga. B) Use of fire fighting equipment C) First aid ; D) Maintenance of Domestic appliances.

4. Modular courses (Optional) : A course module should be designed in the following areas for max. 12 hrs. Batch size – min. 15 students.
Course may be organized internally or with the help of external organizations. **8 Periods**

- a) Forging Technology.
- b) CAD-CAM related software.
- c) Welding techniques.
- d) Personality development.
- e) Entrepreneurship development.

5. 3-D Design using software : Computer screen, coordinate system and planes, definition of HP,VP, reference planes How to create them in 2nd / 3rd environment. Selection of drawing site & scale. Commands of creation of Line, coordinate points, Axis, Poly lines, square, rectangle, polygon, sp line, circles, ellipse, text, move, copy, offset, Mirror, Rotate, Trison, Extend, Break, Chamfer, Fillet, Curves, Constraints fit tangency, perpendicularity, dimensioning Line convention, material conventions and lettering. The Student should draw – Different orthographic Views (including sections), Auxiliary views according to first / Third angle method of projection. (Minimum two sheets, Each containing two problems) after learning the contents as above. **16 Periods**

Total = 48 Periods

EXAMINATION SCHEME

- 1. Continuous Internal Assessment of 25 marks is to be carried out by the teachers throughout the Fourth Semester.
- 2. External Assessment of 25 marks shall be held at the end of the Fourth Semester on the entire syllabus.

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