# SYLLABUS

# DIPLOMA IN METALLURGY

## 2015-2016

**1026**

**M - SCHEME**



**DIRECTORATE OF TECHNICAL EDUCATION**

**GOVERNMENT OF TAMILNADU**

# DIPLOMA IN METALLURGY

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**DIPLOMA COURSES IN ENGINEERING/TECHNOLOGY**

**(SEMESTER SYSTEM)**

**(Implemented from 2015- 2016)**

**M – SCHEME**

**R E G U L A T I O N S***

* *Applicable to the Diploma Courses other than Diploma in Hotel Management & Catering Technology and the Diploma Courses offered through MGR Film Institute, Chennai.*

**1. Description of the Course:**

**a. Full Time (3 years)**

The Course for the full Time Diploma in Engineering shall extend over a period of three academic years, consisting of 6 semesters* and the First Year is common to all Engineering Branches.

**b. Sandwich (3½ years)**

The Course for the Diploma in Engineering (sandwich) shall extend over a period of three and half academic years, consisting of 7 semesters* and the First Year is common to all Engineering Branches. The subjects of three years full time diploma course being regrouped for academic convenience.

During 4th and/or during 7th semester the students undergo industrial training for six months/ one year. Industrial training examination will be conducted after completion of every 6 months of industrial training

**c. Part Time (4 years)**

The course for the diploma in Engineering shall extend over a period of 4 academic years containing of 8 semesters*, the subjects of 3 year full time diploma courses being regrouped for academic convenience.

* Each Semester will have 15 weeks duration of study with 35 hrs. /Week for Regular Diploma Programme and 18hrs/ week (21 hrs. / Week I year) for Part-Time Diploma Programmes.

The Curriculum for all the 6 Semesters of Diploma courses (Engineering & Special Diploma Courses viz. Textile Technology, Leather Technology, Printing Technology, Chemical Technology etc.) have been revised and revised curriculum is applicable for the candidates admitted from 2015 – 2016 academic year onwards.

## 2. Condition for Admission:

Condition for admission to the diploma courses shall be required to have passed in

The S.S.L.C Examination of the Board of Secondary Education, TamilNadu.

(Or)

The Anglo Indian High School Examination with eligibility for Higher Secondary Course in TamilNadu.

(Or)

The Matriculation Examination of Tamil Nadu.

(Or)

Any other Examination recognized as equivalent to the above by the Board of Secondary Education, TamilNadu.

Note: In addition, at the time of admission the candidate will have to satisfy certain minimum requirements, which may be prescribed from time to time.

## 3. Admission to Second year (Lateral Entry):

A pass in HSC ( Academic ) or ( Vocational ) courses mentioned in the Higher Secondary Schools in TamilNadu affiliated to the TamilNadu Higher Secondary Board with eligibility for university Courses of study or equivalent examination, & Should have studied the following subjects.

| Sl. No | Courses | H.Sc Academic | H.Sc Vocational | |
|---|---|---|---|---|
| | | Subjects Studied | Subjects Studied | |
| | | | Related subjects | Vocational subjects |
| 1. | All the Regular and Sandwich Diploma Courses | Maths, Physics & Chemistry | Maths / Physics / Chemistry | Related Vocational Subjects Theory & Practical |
| 2. | Diploma course in Modern Office Practice | English & Accountancy<br><br>English & Elements of Economics<br><br>English & Elements of Commerce | English & Accountancy,<br><br>English & Elements of Economics,<br><br>English & Management Principles & Techniques,<br><br>English & Typewriting | Accountancy & Auditing, Banking, Business Management, Co-operative Management, International Trade, Marketing & Salesmanship, Insurance & Material Management, Office Secretaryship. |

- For the diploma Courses related with Engineering/Technology, the related / equivalent subjects prescribed along with Practical may also be taken for arriving the eligibility.

- Branch will be allotted according to merit through counseling by the respective Principal as per communal reservation.

- For admission to the Textile Technology, Leather Technology, Printing Technology, Chemical Technology and Modern Office Practice Diploma courses the candidates studied the related subjects will be given first preference.

- *Candidates who have studied Commerce Subjects are not eligible for Engineering Diploma Courses.*

**4. Age Limit: No Age limit.**

**5. Medium of Instruction: English**

**6. Eligibility for the Award of Diploma:**

No candidate shall be eligible for the Diploma unless he/she has undergone the prescribed course of study for a period of not less than 3 academic years in any institution affiliated to the State Board of Technical Education and Training, TamilNadu, when joined in First Year and two years if joined under Lateral Entry scheme in the second year and passed the prescribed examination.



The minimum and maximum period for completion of Diploma Courses are as given below:

| Diploma Course | Minimum Period | Maximum Period |
|---|---|---|
| Full Time | 3 Years | 6 Years |
| Full Time(Lateral Entry) | 2 Years | 5 Years |
| Sandwich | 3½ Years | 6½ Years |
| Part Time | 4 Years | 7 Years |

**7. Subjects of Study and Curriculum outline:**

The subjects of study shall be in accordance with the syllabus prescribed from time to time, both in theory and practical. The curriculum outline is given in Annexure **- I**

**8. Examinations:**

Board Examinations in all subjects of all the semesters under the scheme of examinations will be conducted at the end of each semester.

The Internal assessment marks for all the subjects will be awarded on the basis of continuous internal assessment earned during the semester concerned. For each subject 25 marks are allotted for internal assessment and 75 marks are allotted for Board Examination.

## 9. Continuous Internal Assessment:

**A . For Theory Subjects:**

The Internal Assessment marks for a total of 25 marks, which are to be distributed as follows:

**i. Subject Attendance** **5 Marks**

(Award of marks for subject attendance to each subject theory/practical will as per the range given below)

| | | | |
|---|---|---|---|
| 80% | - 83% | ) | 1 Mark |
| 84% | - 87% | | 2 Marks |
| 88% | - 91% | | 3 Marks |
| 92% | - 95% | | 4 Marks |
| 96% | - 100% | | 5 Marks |



**ii) Test #** **10 Marks**

2 Tests each of 2 hours duration for a total of 50 marks are to be conducted. Out of which the best one will be taken and the marks to be reduced to: 05 marks

The Test – III is to be the Model test covering all the five units and the marks so obtained will be reduced to : 05 marks

Total **10 marks**

| TEST | UNITS | WHEN TO CONDUCT | MARKS | DURATION |
|---|---|---|---|---|
| **Test I** | Unit – I & II | End of 6th week | 50 | 2 Hrs |
| **Test II** | Unit – III & IV | End of 12th week | 50 | 2 Hrs |
| **Test III** | **Model Examination** - **Compulsory** Covering all the 5 Units. (Board Examination-question paper-pattern). | End of 15th week | 75 | 3 Hrs |

**# - From the Academic year 2015-2016 onwards.**

Question Paper Pattern for the Periodical Test :( Test - I & Test- II)

With no choice:

| | | |
|---|---|---|
| PART A type questions: | 4 Questions X 2 mark | … … 8 marks |
| PART B type questions: | 4 Questions X 3 marks | … … 12 marks |
| PART C type questions: | 3 Questions X 10 marks | … … 30 marks |
| | | ---------- |
| | **Total** | 50 marks |
| | | ---------- |

**iii) Assignment** **10 Marks**

For each subject Three Assignments are to be given each for 20 marks and the average marks scored should be reduced for 10 marks

All Test Papers and assignment notebooks after getting the signature with date from the students must be kept in the safe custody in the Department for verification and audit. It should be preserved for 2 Semesters and produced to the flying squad and the inspection team at the time of inspection/verification.



**B. For Practical Subjects:**

The internal assessment mark for a total of 25 marks which are to be distributed as follows:-

| | | | |
|---|---|---|---|
| a) | Attendance (Award of marks as same as Theory subjects) | : | **5 Marks** |
| b) | Procedure/ observation and tabulation/ Other Practical related Work | : | **10 Marks** |
| c) | Record writing | : | **10 Marks** |
| | | | ----- |
| | TOTAL | : | **25 Marks** |
| | | | ----- |

- *All the Experiments/exercises indicated in the syllabus should be completed and the same to be given for final board examinations.*
- The Record for every completed exercise should be submitted in the subsequent Practical classes and marks should be awarded for 20 for each exercise as per the above allocation.
- At the end of the Semester, the average marks of all the exercises should be calculated for 20 marks and the marks awarded for attendance is to be added to arrive at the internal assessment mark for Practical. (20+5=25 marks)
- The students have to submit the duly signed bonafide record note book/file during the Practical Board Examinations.

- *All the marks awarded for assignment, Test and attendance should be entered in the Personal Log Book of the staff, who is handling the subject. This is applicable to both Theory and Practical subjects.*

**10. Life and Employability Skill Practical:**

The Life and Employability Skill Practical with more emphasis is being introduced in IV Semester for Circuit Branches and in V Semester for other branches of Engineering.
Much Stress is given to increase the employability of the students:

Internal assessment Mark ….. **25 Marks**

**11. Project Work:**

The students of all the Diploma Programmes **(except Diploma in Modern Office Practice)** have to do a Project Work as part of the Curriculum and in partial fulfillment for the award of Diploma by the State Board of Technical Education and Training, Tamilnadu. In order to encourage students to do worthwhile and innovative projects, every year prizes are awarded for the best three projects i.e. institution wise, region wise and state wise. **The Project work must be reviewed twice in the same semester.**

**a) Internal assessment mark for Project Work & Viva Voce:**

| | | |
|---|---|---|
| Project Review I | … | **10 marks** |
| Project Review II | … | **10 marks** |
| Attendance | … | **05 marks** (award of marks same as theory subjects pattern) |
| Total | … | **25 marks** |



Proper record to be maintained for the two Project Reviews, and It should be preserved for 2 Semesters and produced to the flying squad and the inspection team at the time of inspection/verification.

**b) Allocation of Mark for Project Work & Viva Voce in Board Examination:**

| | | |
|---|---|---|
| Viva Voce | … | **30 marks** |
| Marks for Report Preparation, Demo | … | **35 marks** |
| Total | | **65 marks** |

**c) Written Test Mark (from 2 topics for 30 minutes duration):** $

| | | |
|---|---|---|
| i) Environment Management | 2 questions X 2 ½ marks | = **5 marks** |
| iI) Disaster Management | 2 questions X 2 ½ marks | = **5 marks** |
| | | **10marks** |

$ - Selection of Questions should be from Question Bank, by the External Examiner.

No choice need be given to the candidates.

| | | |
|---|---|---|
| Project Work & Viva Voce in Board Examination | -- | **65 Marks** |
| Written Test Mark (from 2 topics for 30 minutes duration) | -- | **10 Marks** |
| TOTAL | -- | **75 Marks** |

**A neatly prepared PROJECT REPORT as per the format has to be submitted by individual during the Project Work & Viva Voce Board examination.**

## 12. Scheme of Examinations:

The Scheme of examinations for subjects is given in **Annexure - II.**

## 13. Criteria for Pass:

1. No candidate shall be eligible for the award of Diploma unless he/she has undergone the prescribed course of study successfully in an institution approved by AICTE and affiliated to the State Board of Technical Education & Training, Tamil Nadu and pass all the subjects prescribed in the curriculum.



2. A candidate shall be declared to have passed the examination in a subject if he/she secures not less than *40% in theory subjects* and *50% in practical subject* out of the total prescribed maximum marks including both the internal assessment and the Board Examination marks put together, subject to the condition that he/she secures at least a minimum of *30 marks out of 75 marks in the Board's Theory examinations and a minimum of 35 marks out of 75 marks in the Board Practical Examinations.*

## 14. Classification of successful candidates:

Classification of candidates who will pass out the final examinations from April 2018 onwards (Joined in first year in 2015-2016) will be done as specified below.

**First Class with Superlative Distinction:**
A candidate will be declared to have passed in **First Class with Superlative Distinction** if he/she secures not less than 75% of the marks in all the subjects and passes all the semesters in the first appearance itself and passes all subjects within the stipulated period of study 3/ 3½/ 4 years (Full Time/Sandwich/Part Time) without any break in study.

**First Class with Distinction:**
A candidate will be declared to have passed in **First Class with Distinction** if he/she secures not less than 75% of the aggregate of marks in all the

semesters put together and passes all the semesters except the I and II semesters in the first appearance itself and passes all the subjects within the stipulated period of study 3/ 3½/ 4 years (Full Time/Sandwich/Part Time) without any break in study.

**First Class:**

A candidate will be declared to have passed in **First Class** if he/she secures not less than 60% of the aggregate marks in all semesters put together and passes all the subjects within the stipulated period of study 3/ 3½ / 4 years (Full Time/Sandwich/Part Time) without any break in study.

**Second Class:**

All other successful candidates will be declared to have passed in **Second Class.**

The above mentioned classifications are also applicable for the Sandwich / Part-Time students who pass out Final Examination from October 2018 /April 2019 onwards (both joined in First Year in 2015-2016)

**15. Duration of a period in the Class Time Table:**

The duration of each period of instruction is 1 hour and the total period of instruction hours excluding interval and Lunch break in a day should be uniformly maintained as 7 hours corresponding to 7 periods of instruction (Theory & Practical).



**16. Seminar:**

For seminar the total seminar 15 hours(15 weeks x 1hour) should be distributed equally to total theory subject per semester(i.e 15 hours divided by 3/4 subject). A topic from subject or current scenario is given to students. During the seminar hour students have to present the paper and submit seminar material to the respective staff member, who is handling the subject. It should be preserved for 2 Semesters and produced to the flying squad and the inspection team at the time of inspection/verification.

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## ANNEXURE – I

## CURRICULUM OUTLINE

**THIRD SEMESTER**

| Subject Code | SUBJECT | HOURS PER WEEK | | | |
|---|---|---|---|---|---|
| | | Theory Hours | Tutorial / Drawing | Practical hours | Total Hours |
| 32631 | ELEMENTS OF PHYSICAL METALLURGY | 6 | - | - | 6 |
| 32632 | PRODUCTION OF IRON | 6 | - | - | 6 |
| 32633 | ALLIED ENGINEERING | 6 | - | - | 6 |
| 32634 | METALLOGRAPHY PRACTICAL | - | - | 4 | 4 |
| 32635 | FUELS TESTING AND METALLURGICAL ANALYSIS PRACTICAL | - | - | 4 | 4 |
| 32636 | FOUNDRY PRACTICAL | - | - | 4 | 4 |
| 30001 | COMPUTER APPLICATION PRACTICAL ** | - | - | 4 | 4 |
| | Seminar | 1 | - | - | 1 |
| TOTAL | | 19 | - | 16 | 35 |

**FOURTH SEMESTER**

| Subject Code | SUBJECT | HOURS PER WEEK | | | |
|---|---|---|---|---|---|
| | | Theory Hours | Tutorial / Drawing | Practical hours | Total Hours |
| 32641 | HEAT TREATMENT OF METALS AND ALLOYS | 5 | - | - | 5 |
| 32642 | NON-FERROUS EXTRACTIVE METALLURGY | 5 | - | - | 5 |
| 32643 | METAL JOINING | 5 | - | - | 5 |
| 32644 | PRODUCTION OF STEEL | 5 | - | - | 5 |
| 32645 | CAD in METALLURGY PRACTICAL | - | - | 6 | 6 |
| 32646 | HEAT TREATMENT PRACTICAL | - | - | 4 | 4 |
| 32647 | LATHE & SPECIAL MACHINES PRACTICAL | - | - | 4 | 4 |
| | Seminar | 1 | - | - | 1 |
| | TOTAL | 21 | - | 14 | 35 |

**FIFTH SEMESTER**

| Subject Code | SUBJECT | HOURS PER WEEK | | | |
|---|---|---|---|---|---|
| | | Theory Hours | Tutorial / Drawing | Practical hours | Total Hours |
| 32651 | MECHANICAL METALLURGY | 5 | - | - | 5 |
| 32652 | MANUFACTURING PROCESS USING CNC MACHINES | 5 | - | - | 5 |
| 32653 | METAL CASTING | 5 | - | - | 5 |
| ELECTIVE THEORY | | | | | |
| 32671 | NON DESTRUCTIVE TESTING | 5 | - | - | 5 |
| 32672 | CORROSION AND SURFACE ENGINEERING | | | | |
| | | | | | |
| 32655 | CNC MACHINES PRACTICAL | - | - | 5 | 5 |
| 32656 | METAL CASTING PRACTICAL | - | - | 5 | 5 |
| 30002 | LIFE & EMPLOYABILITY SKILL PRACTICAL ** | - | - | 4 | 4 |
| | Seminar | 1 | - | - | 1 |
| | TOTAL | 21 | - | 14 | 35 |

**SIXTH SEMESTER**

| Subject Code | SUBJECT | HOURS PER WEEK | | | |
|---|---|---|---|---|---|
| | | Theory Hours | Tutorial / Drawing | Practical hours | Total Hours |
| 32061 | INDUSTRIAL ENGINEERING AND MANAGEMENT * | 6 | - | - | 6 |
| 32662 | POWDER METALLURGY | 5 | - | - | 5 |
| ELECTIVE THEORY | | | | | |
| 32681 | SELECTION OF MATERIALS | 5 | - | - | 5 |
| 32682 | MATERIALS TECHNOLOGY | | | | |
| 32664 | NON DESTRUCTIVE TESTING PRACTICAL | - | - | 4 | 4 |
| ELECTIVE PRACTICAL | | | | | |
| 32683 | METAL TESTING PRACTICAL | - | - | 4 | 4 |
| 32684 | CORROSION & POWDER METALLURGY PRACTICAL | | | | |
| 32666 | WELDING PRACTICAL | - | - | 6 | 6 |
| 32667 | PROJECT WORK ** | - | - | 4 | 4 |
| | Seminar | 1 | - | - | 1 |
| | TOTAL | 17 | - | 18 | 35 |



*** COMMON WITH MECHANICAL ENGINEERING**

****COMMON FOR ALL BRANCHES**

## ANNEXURE - II
## SCHEME OF THE EXAMINATION

**THIRD SEMESTER**

| Subject Code | SUBJECT | Examination Marks | | | Minimum for pass | Duration of Exam Hours |
|---|---|---|---|---|---|---|
| | | Internal assess-ment Marks | Board Exam. Marks | Total Mark | | |
| 32631 | ELEMENTS OF PHYSICAL METALLURGY | 25 | 75 | 100 | 40 | 3 |
| 32632 | PRODUCTION OF IRON | 25 | 75 | 100 | 40 | 3 |
| 32633 | ALLIED ENGINEERING | 25 | 75 | 100 | 40 | 3 |
| 32634 | METALLOGRAPHY PRACTICAL | 25 | 75 | 100 | 50 | 3 |
| 32635 | FUELS TESTING AND METALLURGICAL ANALYSIS PRACTICAL | 25 | 75 | 100 | 50 | 3 |
| 32636 | FOUNDRY PRACTICAL | 25 | 75 | 100 | 50 | 3 |
| 30001 | COMPUTER APPLICATION PRACTICAL ** | 25 | 75 | 100 | 50 | 3 |
| TOTAL | | 175 | 525 | 700 | | |

**FOURTH SEMESTER**

| Subject Code | SUBJECT | Examination Marks | | | Minimum for pass | Duration of Exam Hours |
|---|---|---|---|---|---|---|
| | | Internal assess-ment Marks | Board Exam Marks | Total Mark | | |
| 32641 | HEAT TREATMENT OF METALS AND ALLOYS | 25 | 75 | 100 | 40 | 3 |
| 32642 | NON-FERROUS EXTRACTIVE METALLURGY | 25 | 75 | 100 | 40 | 3 |
| 32643 | METAL JOINING | 25 | 75 | 100 | 40 | 3 |
| 32644 | PRODUCTION OF STEEL | 25 | 75 | 100 | 40 | 3 |
| 32645 | CAD in METALLURGY PRACTICAL | 25 | 75 | 100 | 50 | 3 |
| 32646 | HEAT TREATMENT PRACTICAL | 25 | 75 | 100 | 50 | 3 |
| 32647 | LATHE & SPECIAL MACHINES PRACTICAL | 25 | 75 | 100 | 50 | 3 |
| TOTAL | | 175 | 525 | 700 | | |

**FIFTH SEMESTER**

| Subject Code | SUBJECT | Examination Marks | | | Minimum for pass | Duration of Exam Hours |
|---|---|---|---|---|---|---|
| | | Internal assess-ment Marks | Board Exam Marks | Total Mark | | |
| 32651 | MECHANICAL METALLURGY | 25 | 75 | 100 | 40 | 3 |
| 32652 | MANUFACTURING PROCESS USING CNC MACHINES | 25 | 75 | 100 | 40 | 3 |
| 32653 | METAL CASTING | 25 | 75 | 100 | 40 | 3 |
| ELECTIVE THEORY | | | | | | |
| 32671 | NON DESTRUCTIVE TESTING | 25 | 75 | 100 | 40 | 3 |
| 32672 | CORROSION AND SURFACE ENGINEERING | | | | | |
| | | | | | | |
| 32655 | CNC MACHINES PRACTICAL | 25 | 75 | 100 | 50 | 3 |
| 32656 | METAL CASTING PRACTICAL | 25 | 75 | 100 | 50 | 3 |
| 30002 | LIFE & EMPLOYABILITY SKILL PRACTICAL ** | 25 | 75 | 100 | 50 | 3 |
| TOTAL | | 175 | 525 | 700 | | |

**SIXTH SEMESTER**

| Subject Code | SUBJECT | Examination Marks | | | Minimum for pass | Duration of Exam Hours |
|---|---|---|---|---|---|---|
| | | Internal assess-ment Marks | Board Exam Marks | Total Mark | | |
| 32061 | INDUSTRIAL ENGINEERING & MANAGEMENT * | 25 | 75 | 100 | 40 | 3 |
| 32662 | POWDER METALLURGY | 25 | 75 | 100 | 40 | 3 |
| ELECTIVE THEORY | | | | | | |
| 32681 | SELECTION OF MATERIALS | 25 | 75 | 100 | 40 | 3 |
| 32682 | MATERIALS TECHNOLOGY | | | | | |
| | | | | | | |
| 32664 | NON DESTRUCTIVE TESTING PRACTICAL | 25 | 75 | 100 | 50 | 3 |
| ELECTIVE PRACTICAL | | | | | | |
| 32683 | METAL TESTING PRACTICAL | 25 | 75 | 100 | 50 | 3 |
| 32684 | CORROSION & POWDER METALLURGY PRACTICAL | | | | | |
| | | | | | | |
| 32666 | WELDING PRACTICAL | 25 | 75 | 100 | 50 | 3 |
| 32667 | PROJECT WORK ** | 25 | 75 | 100 | 50 | 3 |
| TOTAL | | 175 | 525 | 700 | | |



*** COMMON WITH MECHANICAL ENGINEERING**

****COMMON FOR ALL BRANCHES**

**Diploma in Metallurgy M Scheme**

(With effect from 2015-2016)

**List of Equivalent Subjects of L-Scheme to M Scheme**

**III SEMESTER W. E. F OCT '16**

| | **L - SCHEME** | | **M - SCHEME** | |
|---|---|---|---|---|
| Sl. No | Subjects Code | Name of Subject | Subject code | Name of Subject |
| 1 | 22631 | Elements of Physical Metallurgy | 32631 | Elements of Physical Metallurgy |
| 2 | 22632 | Iron Making | 32632 | Production of Iron |
| 3 | 22633 | Allied Engineering | 32633 | Allied Engineering |
| 4 | 22634 | Metallography Practical | 32634 | Metallography Practical |
| 5 | 22635 | Fuels Testing & Met Analysis Practical | 32635 | Fuels Testing & Metallurgical Analysis Practical |
| 6 | 22045 | Manufacturing Technology - I Practical * | 32036 | Lathe and Drilling Practical |
| 7 | 20001 | Computer Applications Practical ** | 30001 | Computer Applications Practical ** |

## IV SEMESTER – W.E.F APR '17

| | L - SCHEME | | M - SCHEME | |
|---|---|---|---|---|
| Sl. No | Subjects Code | Name of Subject | Subject code | Name of Subject |
| 1 | 22641 | Heat Treatment of Metals and Alloys | 32641 | Heat Treatment of Metals and Alloys |
| 2 | 22642 | Non-Ferrous Extractive Metallurgy | 32642 | Non-Ferrous Extractive Metallurgy |
| 3 | 22643 | Metal Joining | 32643 | Metal Joining |
| 4 | 22644 | Steel Making | 32644 | Production of Steel |
| 5 | 22044 | Computer Aided Machine Drawing Practical* | 32034 | Computer Applications and CAD Practical |
| 6 | 22646 | Heat Treatment Practical | 32646 | Heat Treatment Practical |
| 7 | 22647 | Welding Practical | 32666 | Welding Practical [**W. E. F. AP '18]** |



## V SEMESTER – W.E.F OCT '17

| | L - SCHEME | | M - SCHEME | |
|---|---|---|---|---|
| Sl. No | Subjects Code | Name of Subject | Subject code | Name of Subject |
| 1 | 22651 | Mechanical Metallurgy | 32651 | Mechanical Metallurgy |
| 2 | 22062 | Computer Integrated Manufacturing * | 32062 | Computer Aided Design and Manufacturing [**W. E. F. AP '18]** |
| 3 | 22653 | Metal Casting | 32653 | Metal Casting |
| 4 | 22654 | Non Destructive Testing | 32671 | Non Destructive Testing |
| 5 | 22064 | Computer Integrated Manufacturing Practical * | 32064 | Computer Aided Design and Manufacturing Practical [**W. E. F. AP '18]** |
| 6 | 22657 | Metal Casting Practical | 32656 | Metal Casting Practical |
| 7 | 20002 | Communication & Life Skills Practical ** | 30002 | Life & Employability Skills Practical ** |

**VI SEMESTER - W. E. F. APR '18**

**L - SCHEME** **M - SCHEME**

| Sl. No | Subjects Code | Name of Subject | Subject code | Name of Subject |
|---|---|---|---|---|
| 1 | 22061 | Industrial Engineering & Management * | 32061 | Industrial Engineering and Management * |
| 2 | 22662 | Powder Metallurgy | 32662 | Powder Metallurgy |
| Elective Theory | | | | |
| 3 | 22681 | Selection of Materials | 32681 | Selection of Materials |
| | 22682 | Materials Technology | 32682 | Materials Technology |
| | | | | |
| 4 | 22664 | Non Destructive Testing Practical | 32664 | Non Destructive Testing Practical |
| Elective Practical | | | | |
| 5 | 22683 | Metal Testing Practical | 32683 | Metal Testing Practical |
| | 22684 | Corrosion & Powder Metallurgy Practical | 32684 | Corrosion & Powder Metallurgy Practical |
| | | | | |
| 6 | 22666 | Foundry Practical | 32636 | Foundry Practical |
| 7 | 22667 | Project work ** | 32667 | Project work ** |



*** COMMON WITH MECHANICAL ENGINEERING**

****COMMON FOR ALL BRANCHES**

**Board Examination - Question paper pattern**

**Common for all theory subjects**
**Unless it is specified**

***PART A*** ***- (1 to 8) 5 Questions are to be answered out of 8 questions for 2 marks each.*****(Question No. 8 will be the compulsory question and *can be asked from any one of the units)(From each unit maximum of two 2 marks questions alone can be asked)***

***PART B*** ***- (9 to 16)5 Questions are to be answered out of 8 questions for 3 marks each.*** **(Question No. 16 will be the compulsory question and *can be asked from any one of the units) (From each unit maximum of two 3 marks questions alone can be asked)***

***PART C*** ***- (17 to 21) Five Questions will be in the Either OR Pattern. Students have to answer these five questions. Each question carries 10 marks. (Based on the discretion of the question setter, he/she can ask two five mark questions (with sub division A & sub division B) instead of one ten marks question if required)***

## III SEMESTER

DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN METALLURGY

II YEAR

M SCHEME

III SEMESTER

2015 -2016 onwards



# 32631 – ELEMENTS OF PHYSICAL METALLURGY

CURRICULUM DEVELOPMENT CENTRE

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**

**DIPLOMA IN METALLURGY**
**M-SCHEME**
**(To be implemented to the student admitted from the Year 2015-2016 on wards)**

Course Name : DIPLOMA IN METALLURGY
Course Code : 1026
Subject Code : **3**2631
Semester : III Semester
Subject Title : **ELEMENTS OF PHYSICAL METALLURGY**

**TEACHING AND SCHEME OF EXAMINATION:**

No of weeks per semester: 15 weeks

| Subject Title | Instructions | | Examination | | | |
|---|---|---|---|---|---|---|
| | Hours /Week | Hours /Semester | Marks | | | Duration |
| | | | Internal Assessment | Board Examination | Total | |
| Elements of Physical Metallurgy | 6 Hrs | 15 X 6 = 90 Hrs | 25 | 75 | 100 | 3 Hrs |



**Topics and Allocation of Hours:**

| Unit No | Topic | Time(Hrs) |
|---|---|---|
| I | ATOMIC STRUCTURE, ELECTRONIC CONFIGURATION, CRYSTAL STRUCTURES, CRYSTAL SYSTEMS, AND CRYSTAL DEFECTS | 17 |
| II | PRINCIPLES OF DIFFUSION, RECOVERY, RECRYSTALLIZATION, GRAIN GROWTH, MECHANICAL, ELECTRICAL & MAGNETIC PROPERTIES OF ENGINEERING MATERIALS | 17 |
| III | PHASE DIAGRAMS: ISOMORPHOUS, EUTECTIC TYPE I & II, EUTECTOID | 17 |
| IV | FE-C SYSTEM & SOLIDIFICATION PRINCIPLES | 17 |
| V | METALLOGRAPHY & FRACTURE SURFACES | 15 |
| | REVISION AND TEST | 7 |
| Total | | 90 |

**RATIONALE:**

This subject is the basic fundamental for all Metallurgical subjects. All engineering fields are dealing with components made of different materials of widely varied nature in order to meet ever growing needs of modern world's needs. To select the materials, process them to suit our expectations, design and manufacture of components to perform adequately in the application.

All above are concepts are provided to the students starting from atomic perspective then through materials combinations and their behaviour from view point of phase diagrams and the solidification phenomenon and subsequent processing techniques. Various possible defects at atomic level and bulk level are helpful in providing the ways to analyze the root cause of occurrences of defects and how to control them. Also it provides the analysis various phases and defects at micro-structural level using Optical microscopy and Electron microscopy.

**OBJECTIVES:**

At the end of the study of III Semester the student will be able to

- The internal symmetry of crystal systems and their related properties & defects will be understood.
- Acquire knowledge about the construction and application of various phase diagrams.
- Able to analyze the microstructures and their related properties of materials.
- Understand the Fe-C phase diagram, various phases & how to control the properties by controlling the phases.
- Get knowledge about the mechanism of solidification & controlling the properties of poly-crystalline material by controlling of Grain size etc.
- Imparts information about the micro and macro structural studies and various microscopes.
- Various mechanisms of fracture surface appearance of the materials could be understood.

## 32631 - ELEMENTS OF PHYSICAL METALLURGY

DETAILED SYLLABUS

Contents: Theory

| Unit | Name of the Topic | Hours |
|---|---|---|
| I | **ATOMIC STRUCTURE, ELECTRONIC CONFIGURATION, CRYSTAL STRUCTURES, CRYSTAL SYSTEMS, AND CRYSTAL DEFECTS:**<br>Introduction to metallurgy.<br>Branches of metallurgy namely chemical, physical & mechanical.<br>Levels of Structure, Structure – Property relationship.<br><br>**ATOMIC STRUCTURE:**<br>Atom, definition, principal particles, Atomic structure by: J.J. Thomson, Rutherford's & Bhor's.<br>Quantum numbers, Pauli's Exclusion principle, Electronic configuration - principles only.<br><br>**CRYSTAL STRUCTURE AND CRYSTAL SYSTEMS:**<br>Definitions of crystalline & amorphous materials, crystal, space lattice, unit cell, co-ordinate axes, lattice points, characteristic Intercepts, Interstitial angle & lattice parameters.<br><br>General Classification of crystal systems: Definitions for atomic radius, inter-atomic spacing, co-ordination number, effective number of atoms per unit cell, packing factor for BCC, FCC systems.<br>HCP system- basics.<br>Miller Indices - crystallographic planes & directions.<br><br>**CRYSTAL IMPERFECTIONS**:<br>Points defects:<br>Vacancies, Interstitials, substitutional- ordered & disordered, Frankel, Schotkey defects.<br>Line defects: Edge & screw dislocations with burger's circuit.<br>Slip system - slip directions and planes. Schmid's law.<br>Surface imperfection: External surface imperfection, grains & grain boundary, twin boundary, tilt boundary & stacking fault.<br>Volume defects: Tetrahedral & Octahedral voids Thermal vibration.<br>Effect of imperfection and Grain size on metal properties.<br>ASTM Grain size measurement. | 17 |
| II | **PRINCIPLES OF DIFFUSION, RECOVERY, RECRYSTALLIZATION, GRAIN GROWTH, MECHANICAL, ELECTRICAL & MAGNETIC PROPERTIES OF ENGINEERING MATERIALS**<br><br>**DIFFUSION:**<br>Diffusion: Law's of diffusion - Fick's I law - diffusion coefficient versus | 17 |

| | | |
|---|---|---|
| | temperature - Fick's II law. Interdiffusion and kirkendall effect.<br>Cold worked structure, Recovery, Recrystallization & Grain Growth.<br><br>**MECHANICAL PROPERTIES:**<br>Stress, Strain, Stress-Strain Diagram for Ductile & Brittle materials,<br>Elasticity, Plasticity, Proportional limit, Elastic limit, Yielding phenomenon,<br>UYP & LYP, UTS, Fracture<br>stress, Resilience, Toughness, Brittleness,<br>Measure of Ductility & Malleability: Elongation in length,<br>Reduction in cross-sectional area. Hardness, Wear resistance,<br>Machinability, Castability & Weldability,<br><br>**ELECTRICAL PROPERTIES:**<br>Definition of conductivity, resistivity, Band theory - conductors, insulators and Semi- conductors in terms of band theory.<br><br>**MAGNETIC PROPERTIES:**<br>Magnetic Domain, magnetic moment - types of magnetic behavior like dia, Para, Ferro, Anti-Ferro & Ferri Magnetic behavior - basics only.<br>Hysteresis loop, Hysteresis loss for soft & hard magnets - basics only. | |
| **III** | **PHASE DIAGRAMS**<br>Constitution of alloys.<br>Solid Solutions & Compounds.<br>Hume - Rothery rules for Primary Substitutional Solid Solutions.<br>Phase diagram & their applications.<br>Coordinates of phases, phase rule & definition of basic terms involved.<br>Unary phase diagram. –for Magnesium.<br>Binary phase diagram:<br>Cooling curves for pure metals, Solid solution alloys & Eutectic type alloys.<br>Lever rule and Tie line rule.<br>Construction of Isomorphous phase diagram using cooling curves & solidification<br>Mechanisms for various alloys for Isomorphous, Eutectic type I &<br>Eutectic type II systems with examples.<br>Eutectoid system - Basic consideration. | **17** |
| **IV** | **Fe-C SYSTEM & SOLIDIFICATION PRINCIPLES**<br>Cooling curve for pure iron.<br>Iron - Carbon equilibrium diagram – critical: points, temperatures, reaction, phases & regions.<br>Definition of Ferrite, Austenite, Cementite, Leduberite, Pearlite, martensite, Bainite & trootsite.<br>Introduction to TTT & CCT diagram. | |

| Unit | Name of the Topic | Hours |
|---|---|---|
| | Steel Specifications – Indian Standards & AISI standards.<br>Solidification of metals: Introduction - concept of solidification of pure metals and alloys.<br>Liquid metal nucleation- Homogenous & Heterogeneous with nucleation rate curve.<br>Crystal growth from liquid phase, Distribution co-efficient and solute distribution – Constitutional super cooling - Dendrite growth in Pure metals & alloys.<br>Freezing of ingots.<br>Segregation/coring – micro Segregation & macro Segregation.<br>Porosity. | **17** |
| **V** | **METALLOGRAPHY**<br>Introduction and definition.<br>Metallurgical microscopes.<br>Preparation of specimen for micro study.<br>Mounting process.<br>Micro & macro enchants for different metals & alloys.<br>Elementary ideas on Transmission Electron Microscope (TEM) & Scanning Electron Microscope (SEM).<br>Fractured surfaces appearance: Ductile, Brittle, Fatigue and creep fractured Surfaces -basic only.<br>Sulphur printing. | **15** |



**Text Book:**

1. A Text book of Material Science & Metallurgy,
O.P.Khanna & M.Lal, Dhanpat Rai & Sons, New Delhi.

**Reference Books:**

1. Elements of Physical Metallurgy, A.C. Guy & J.J.Hren IIIrd Edition, Oxford & IBH Publishing, New Delhi 1974. Co.,
2. Physical Metallurgy Principles, II Edition Reed Hill R.E., East – West Press Pvt.Ltd, New Delhi- 1973.
3. Metallurgy for Engineers, IV Edition, E.C. Rollason English Language Book Society
4. Introduction to Physical Metallurgy Sidney H.Avner McGraw Hill International Book Co., New Delhi 1902
5. Physical Metallurgy Principle and Practice, V.Raghavan Prentice - Hall of India Pvt Ltd., New Delhi 1985.
6. The Science of Engineering of Materials, 4th Edition, Donald R.Askeland, & Pradeep P.Pule, Brookes Cole Engineering Division, Montery, US.
7. Physical Metallurgy Principles, Vijendra Singh, 1st Edition, Standard Publishers Distributors, Delhi

DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN METALLURGY

II YEAR

M SCHEME

III SEMESTER



2015 -2016 onwards

# 32632 – PRODUCTION OF IRON

CURRICULUM DEVELOPMENT CENTRE

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**

**DIPLOMA IN METALLURGY**
**M-SCHEME**
**(To be implemented to the student admitted from the Year 2015-2016 on wards)**

Course Name : DIPLOMA IN METALLURGY
Course Code : 1026
Subject Code : **3**2632
Semester : III Semester
Subject Title : **PRODUCTION OF IRON**

**TEACHING AND SCHEME OF EXAMINATION:**

No of weeks per semester: 15 weeks

| Subject Title | Instructions | | Examination | | | |
|---|---|---|---|---|---|---|
| | Hours /Week | Hours /Semester | Marks | | | Duration |
| | | | Internal Assessment | Board Examination | Total | |
| Production Of Iron | 6 Hrs | 15 X 6 = 90 Hrs | 25 | 75 | 100 | 3 Hrs |



**Topics and Allocation of Hours:**

| **Unit No** | Topic | Time(Hrs) |
|---|---|---|
| I | MINERAL DEPOSITS, FUELS, FLUXES, BENEFICIATION PROCESS | 17 |
| II | RAW MATERIAL, BLAST FURNACE BURDEN PREPARATION, | 17 |
| III | BLAST FURNACE CONSTRUCTION, OPERATION, CONTROL, SLAG PROPERTIES | 17 |
| IV | ALTERNATIVE ROUTES FOR IRON MAKING | 17 |
| V | CAST IRON –TYPES ,PROCEDURE ETC | 15 |
| | REVISION AND TEST | 7 |
| TOTAL | | 90 |

**RATIONALE:**

Study of iron making has plays the major role in metallurgical engineer. In almost all engineering industries the use of iron product is inevitable and also it is a basic for metallurgical engineer. Due to this, the ores of iron, mineral beneficiations are in 1st unit. Blast furnace operation construction principles and other methods of iron production are studied in lateral units.

By studying this subject a student can understand the different methods, preparations and procedures for iron making.

**OBJECTIVES:**

At the end of the study of III Semester the student will be able to

- Know about the Iron minerals deposits in India
- Learn about the beneficiation treatments.
- Know about the various types of sinters
- Know about the raw materials for iron making.
- Study about the Blast furnace- principles, operation, and construction and Gas cleaning system.
- Learn about the Sponge iron production.

## 32632 - PRODUCTION OF IRON

DETAILED SYLLABUS

Contents: Theory

| Unit | Name of the Topic | Hours |
|---|---|---|
| I | **MINERAL DEPOSITS, FUELS, FLUXES, BENEFICIATION PROCESS:**<br><br>**Ore minerals of iron** - types of ore - Iron ore deposits in India.<br>**Ore beneficiation treatments- Crushing- jaw, hammer mill, gravity stamp mill-** construction & operation- Grinding-ball mill – construction & operation<br>Concentration: Sorting. Heavy media separation: jigging, tabling, Electro – static separation.-Magnetic concentration<br>**Fuel-** metallurgical coal-CRI-CSR it importance in efficient blast furnace operation—coke manufacture- by-product recovery-<br>**Fluxes** | **17** |
| II | **BLAST FURNACE BURDEN PREPARATION :**<br><br>**Agglomeration** - sintering - types of sinters - Dwight - Lloyd sintering machine-<br>productivity-pellatisation - briquetting - nodularising-<br>**Testing of burden materials**.-<br>**gas cleaning**- dust catcher, spray tower, electro static precipitator<br>**preheating the blast**-hot blast stoves accessories-<br>**charging equipment** –charging system hoisting appliances - | **17** |
| III | **BLAST FURNACE CONSTRUCTION, OPERATION, CONTROL, SLAG PROPERTIES**<br><br>**Construction of blast furnace** - various parts- zones- dimensions- Linings<br>Principles of Iron making.<br>**Operation and contro**l of blast furnace –metal and slag-operational irregularities and their remedies of blast furnace- **thermodynamic equilibrium**-physical ,thermal and chemical profiles-physical chemistry of blast furnace process-kinetics of reduction- thermal efficiency-desulphurisation and desiliconisation | **17** |

| Unit | Name of the Topic | Hours |
|---|---|---|
| IV | **ALTERNATIVE ROUTES FOR IRON MAKING :**<br><br>Low shaft furnace<br>charcoal furnace<br>Electro-thermal processes-<br>Sponge iron production<br>Melting reduction process-Corex, Hismet and Finmet | **17** |
| V | **CAST IRON:**<br>Introduction to cast iron<br>Types of cast iron.<br>Microstructure of various types of cast iron.<br>Composition, characteristics and applications of gray cast iron.<br>Graphite flakes size and distribution-groupings.<br>Construction and operation of cupola furnace.<br>Various zones of cupola furnace.<br>Melting of gray cast iron<br>Composition, characteristics and applications of white cast iron.<br>Melting of white cast iron.<br>Composition, characteristics and applications of S.G iron.<br>Melting of S.G iron.<br>Nodularity and nodule count.<br>Composition, characteristics and applications of malleable iron. | **15** |



**Text Books:**

1. Introduction to modern Iron Making, Dr. R.H.Tupkary, Khanna publishers, Delhi

**Reference Books:**

1. Extractive Metallurgy, Newton. Wiley Eastern. New Delhi, 1967
2. Manufacture of Iron and Steel, Vol I, G.Reginald Bash Forth Chapman & Hall. London. 1964
3. Elements of Metallurgy, Dr.Swarup, Rastogi Publication.
4. Ore dressing Hardware, Teggart
5. Extraction Metallurgy, Gilchrist, 2nd edition, Pergamon Press. London, 1981.
6. Making Shaping and Treating of Steel, U.S. Steel Corporation. 1994.

DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN METALLURGY

II YEAR

M SCHEME

III SEMESTER



2015 -2016 onwards

**32633 - ALLIED ENGINEERING**

CURRICULUM DEVELOPMENT CENTRE

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**

**DIPLOMA IN METALLURGY**
**M-SCHEME**
**(To be implemented to the student admitted from the Year 2015-2016 on wards)**

Course Name : DIPLOMA IN METALLURGY
Course Code : 1026
Subject Code : **3**2633
Semester : III Semester
Subject Title : **ALLIED ENGINEERING**

**TEACHING AND SCHEME OF EXAMINATION:**

No of weeks per semester: 15 weeks

| Subject Title | Instructions | | Examination | | | |
|---|---|---|---|---|---|---|
| | Hours /Week | Hours /Semester | Marks | | | Duration |
| | | | Internal Assessment | Board Examination | Total | |
| Allied Engineering | 6 Hrs | 15 X 6 = 90 Hrs | 25 | 75 | 100 | 3 Hrs |



**Topics and Allocation of Hours:**

| **Unit No** | Topic | Time(Hrs) |
|---|---|---|
| I | FUELS | 17 |
| II | FURNACES | 17 |
| III | REFRACTORIES | 17 |
| IV | BASICS OF CIVIL & ELECTRICAL ENGINEERING | 16 |
| V | BASICS OF MECHANICAL ENGINEERING | 16 |
| | REVISION AND TEST | 7 |
| TOTAL | | 90 |

**RATIONALE:**

Fundamental aspects of various Metallurgical Fuels, Furnaces and refractories has to be thoroughly understood, which helps in selection of right type of fuels such that which will not interact with and impair the components made. This subject provides various types of furnaces based on the process to be performed like Melting, Heat Treatment etc,. The right selection of refractory for successful processing route helps in obtaining the sound components free from defects and so on. A basic fundamental knowledge about various branches of other engineering fields also is a must to understand the concepts of Engineering related with Metallurgy.

**OBJECTIVES:**

At the end of the study of III Semester the student will be able to

- Know about various types of fuels and its terms
- Study about the properties of fuels.
- Learn about the production of metallurgical coke.
- Properties and uses of solid, liquid , gaseous fuels
- Know about the destructive distillation of petroleum products.
- Study about the production of gaseous fuels.
- Learn about the Storage and handling of fuels.
- Various types of furnaces & their operating principles will be understood
- Efficiency of the furnaces will impart the effective utilization of energy
- Gives an introduction to Various types of Refractories
- Properties & testing procedures will be understood
- Know how to select proper refractory for specific application
- Basic knowledge in Civil & Electrical will be beneficial to the student
- Study of lathe, radial drilling machine & other machineries will be useful to them
- Various Non-conventional energy sources are exposed to them

## 32633 - ALLIED ENGINEERING

DETAILED SYLLABUS

Contents: Theory

| Unit | Name of the Topic | Hours |
|---|---|---|
| I | **FUELS :**<br><br>Fuels: Introduction, Classification, Calorific value and other properties, Combustion.<br>Solid Fuels: Wood, Varieties of coal, Manufacture of metallurgical coke<br>Liquid fuels: Petroleum and its derivatives, Destructive distillations, properties of liquid fuels<br>Gaseous fuels: Production, properties and uses of water gas, producer gas, liquefied petroleum gas, coal gas, bio-gas, Cobar -gas, storage and safety handling of fuels. | 17 |
| II | **FURNACES :**<br><br>Classification of furnaces, Cupola, Induction F/c, Rotary, Electric Arc furnaces, Open-Hearth type furnaces, Muffle furnace, Elements for furnace construction.<br>Maintenance and safety of furnaces. | 17 |
| III | **REFRACTORIES**<br>Definition –Criteria for selecting refractory - Classification of refractories based on chemical nature, Heat duty & manufacturing method.<br>Occurrence of refractory materials in India.<br>Properties: Refractoriness, RUL, Specific gravity, Compression strength (CCS & HCS), Spalling resistance, Porosity, Modulus of Rupture strength, Abrasion resistance & their testing methods. Shapes of Refractory bricks. General Manufacturing method of refractory bricks. Manufacture of Silica & Fireclay bricks. Alumina, Dolomite, Chromite, Magnesite, Chrome-Magnetite, & Silimanite bricks – basics.<br>Storage and safety handling of refractories. | 17 |

| Unit | Name of the Topic | Hours |
|---|---|---|
| IV | **BASICS OF CIVIL ENGINEERING**<br>Stones – Classification – Requirements – Uses<br>Bricks – Manufacture – Requirements of good bricks<br>Lime – Importance's – Classification – Uses Cement –<br>Raw materials – Manufacture – Grades of cement – Types.<br>Timbers – Varieties – Uses – Timber products –<br>Seasoning of Timber.<br><br>**BASICS OF ELECTRICAL ENGINEERING**<br>Basic Electricity-definition of voltage, current, power, Energy, - Ohm's law, laws of resistance and temperature co-efficient of resistance. Generation of A.C. fundamentals, cycle, frequency, Time period. Faraday's law's of electro magnetic induction.<br>Electric heating: Principle-types of heating like direct resistance heating, indirect resistance heating, Induction heating, Dielectric heating.<br>Electric welding: Principle- Types- resistance welding- Arc welding.<br>Electrolysis: Principle - Process - Applications like extraction of metals - refining of metals. | **16** |
| V | **BASICS OF MECHANICAL ENGINEERING**<br>Definition manufacturing process–types of manufacturing process–centre lathe (line diagram with explaination only)– Definition and comparisons of planer, shaper, slotter–Double housing planer, standard shaper, standard slotter (line diagram with explain only) – Definition Drilling, Milling, Grinding, Broaching & Boring- Plain radial drilling machine, plain milling machine, pedestal grinder, bench grinder, portable grinder, horizontal broaching machine, vertical boring machine (line diagram with explain only)-<br>**Power Plant**- solar power plant, wind mill, geothermal power plant, Hydal power plant (line diagram with explain only). | **16** |



**Text Book**

1. Fuels, Furnaces & Refractories, Gupta O.P, Khanna publishers, New Delhi.
2. Engineering Chemistry, P.C.Jain & Manica Jain, Dhanpatrai & Sons, Delhi 1986.

**Reference Books**

1. Workshop Technology Vol.I & II, Hajra Choudry and Basu S.K. Media Promoters Pub, Mumbai.
2. Building Materials, S.C.Rangwala, Charotar Pub,Anand
3. Electrical Technology, H.Cotton, CBS Pub, Delhi

4. A Text book of Electrical Engg, S.L.Uppal, Khanna Pub, Delhi
5. Mineral Processing Technology, 3rd Edition, Wills.B.A., Pergamon Press, 1989
6. Elements of Fuels, Furnaces and Refractories, 4th Edition, Gupta.O.P Khanna Publishers, New Delhi, 2000.
7. Extraction Metallurgy, 2nd Edition, Gilchrist.J.D., Pergamon Press, 1980
8. Fuels and Furnace Technology, Balusamy.V., Lecture Notes, 1996.
9. Ore Processing, Jain.S.K., Oxford and IBH, 1986.

DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN METALLURGY

II YEAR

M SCHEME

III SEMESTER



2015 -2016 onwards

# 32634 – METALLOGRAPHY PRACTICAL

CURRICULUM DEVELOPMENT CENTRE

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**

**DIPLOMA IN METALLURGY**
**M-SCHEME**
**(To be implemented to the student admitted from the Year 2015-2016 on wards)**

Course Name : DIPLOMA IN METALLURGY
Course Code : 1026
Subject Code : 32634
Semester : III Semester
Subject Title : **METALLOGRAPHY PRACTICAL**

**TEACHING AND SCHEME OF EXAMINATION:**

No of weeks per semester: 15 weeks

| Subject Title | Instructions | | Examination | | | |
|---|---|---|---|---|---|---|
| | Hours /Week | Hours /Semester | Marks | | | Duration |
| | | | Internal Assessment | Board Examination | Total | |
| Metallography Practical | 4 Hrs | 15 X 4 = 60 Hrs | 25 | 75 | 100 | 3 Hrs |



**RATIONALE:**

The Structure – property relationship is the vital one in fixing the properties of the components made. The micro-structure from micro & macro levels helps in establishing the qualitative condition of the parts made. Study of micro-structures from practical view point of various Ferrous & Non-ferrous samples helps in better understanding of the materials and related properties from practical view points.

**GUIDELINES:**

- All the experiments given in the list of experiments should be completed and given for the end semester practical examination.
- In order to develop best skills in handling Instruments/Equipment and taking readings in the practical classes, every two students should be provided with a separate experimental setup for doing experiments in the laboratory.

- The external examiners are requested to ensure that a single experimental question should not be given to more than four students while admitting a batch of 30 students during Board Examinations.

**ALLOCATION OF MARKS**

| | |
|---|---|
| Procedure | 20 marks |
| Specimen preparation | 20 marks |
| Microstructure and Identification of phase's | 20 marks |
| Result | 10 marks |
| Viva-voce | 05 marks |
| Total | 75 Marks |

**COMPLETE LIST OF EXPERIMENTS IN DETAIL**



1. Operating procedures & principles of metallurgical optical microscope
2. Preparation of specimen for micro-examination & macro-examination
3. Micro & Macro etchant preparation
4. Specimen Mounting on PVC base
5. Micro-examination of Low carbon steel
6. Micro-examination of Medium carbon steel
7. Micro-examination of High carbon steel
8. Micro-examination of S.G. Iron
9. Micro-examination of Grey cast iron
10. Micro-examination of Martensitic structure
11. Micro-examination of Copper
12. Micro-examination of Brass

## LIST OF EQUIPMENTS

## AND THE QUANTITY REQUIRED FOR A BATCH OF 30 STUDENTS

| | | |
|---|---|---|
| 1. | Metallurgical Optical Microscope | 2 Nos. |
| 2. | Metallurgical Optical Invertoscope | 2 Nos. |
| 3. | Bench Grinder | 1 No. |
| 4. | Belt Emery Polisher | 1 Nos. |
| 5. | Double Disc Polisher | 2 Nos. |
| 6. | Specimen Mounting Machine | 1 No. |
| 7. | Emery papers (220,320, 400 & 600) | 30 each. |
| 8. | Polishing grade Alumina powder | 500 gms. |
| 9. | Specimens of Mild steel, Medium carbon steel, High carbon steel, S.G.Iron, Grey iron, Martensitic specimen, Copper and Brass. | 30 Nos. each |

DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN METALLURGY

II YEAR

M SCHEME



III SEMESTER

2015 -2016 onwards

**32635 - FUELS TESTING AND METALLURGICAL ANALYSIS PRACTICAL**

CURRICULUM DEVELOPMENT CENTRE

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**

**DIPLOMA IN METALLURGY**
**M-SCHEME**
**(To be implemented to the student admitted from the Year 2015-2016 on wards)**

| | | |
|---|---|---|
| Course Name | **:** | DIPLOMA IN METALLURGY |
| Course Code | : | 1026 |
| Subject Code | **:** | **3**2635 |
| Semester | **:** | III Semester |
| Subject Title | **:** | **FUELS TESTING AND METALLURGICAL ANALYSIS PRACTICAL** |

**TEACHING AND SCHEME OF EXAMINATION:**

No of weeks per semester: 15 weeks

| Subject Title | Instructions | | Examination | | | |
|---|---|---|---|---|---|---|
| | Hours /Week | Hours /Semester | Marks | | | Duration |
| | | | Internal Assessment | Board Examination | Total | |
| Fuels Testing and Metallurgical Analysis Practical | 4 Hrs | 15 X 4 = 60 Hrs | 25 | 75 | 100 | 3 Hrs |



**RATIONALE:**

Fuels are graded by its calorific value. Presence of moisture, volatile matter ,ash decreases the calorific value particularly for solid fuels to measure solid and liquid fuels calorific value the different type of testing procedure are studied here.

And also, ash content, moisture content, volatile matter of given fuel will be found out under this lab. In steel its properties are greatly affected by its composition mainly C, Si, Mn, S etc. So that the testing methods of finding the % of C, Si, S are also studied here.

**GUIDELINES:**

- All the experiments given in the list of experiments should be completed and given for the end semester practical examination.
- In order to develop best skills in handling Instruments/Equipment and taking readings in the practical classes, every two students should be provided with a separate experimental setup for doing experiments in the laboratory.

- The external examiners are requested to ensure that a single experimental question should not be given to more than four students while admitting a batch of 30 students during Board Examinations.

## ALLOCATION OF MARKS

| | |
|---|---|
| Procedure, Formula | 10 marks |
| Observation, Equipment handling | 20 marks |
| Tabulation, Readings, graph/figure | 20 marks |
| Calculation | 15marks |
| Result | 05 marks |
| Viva Voce | 05 marks |
| Total | 75 Marks |

## COMPLETE LIST OF EXPERIMENTS IN DETAIL



1. Sampling – Coning & Quartering
2. Estimation of Flash and Fire point of liquid fuel using open cup apparatus
3. Estimation of Flash and Fire point of liquid fuel using closed cup apparatus
4. Estimation of Kinematic viscosity of Caster oil using Saybolt viscometer
5. Estimation of Kinematic viscosity of Coconut oil using Saybolt viscometer
6. Estimation of Kinematic viscosity of Caster oil using Redwood's viscometer
7. Estimation of Kinematic viscosity of Coconut oil using Redwood's viscometer
8. Estimation of Calorific value of solid fuels using Bomb Calorimeter
9. Estimation of Moisture content in coke
10. Estimation of Volatile matter of coke
11. Estimation of Ash content of coke
12. Estimation of Sulphur in S.G.Iron

## LIST OF EQUIPMENTS

## AND THE QUANTITY REQUIRED FOR A BATCH OF 30 STUDENTS

| | | |
|---|---|---|
| 1. | Sampling tray | 1 No |
| 2. | Open cup apparatus | 3 No |
| 3. | Closed cup apparatus | 3 No |
| 4. | Saybolt viscometer | 3 No |
| 5. | Redwoods viscometer | 3 No |
| 6. | Bomb calorie meter | 1No |
| 7. | Muffle furnace | 1 No |
| 8. | Digital Balance | 2 No |
| 9. | Thermometer | 15 No |
| 10. | Silica Crucible | 5 No |
| 11. | Oxygen cylinder | 1 No |
| 12. | Strohlein apparatus | 1 No |

DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN METALLURGY

II YEAR

M SCHEME

III SEMESTER

2015 -2016 onwards



**32636 – FOUNDRY PRACTICAL**

CURRICULUM DEVELOPMENT CENTRE

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**

**DIPLOMA IN METALLURGY**
**M-SCHEME**
**(To be implemented to the student admitted from the Year 2015-2016 on wards)**

| | | |
|---|---|---|
| Course Name | **:** | DIPLOMA IN METALLURGY |
| Course Code | : | 1026 |
| Subject Code | **:** | **3**2636 |
| Semester | **:** | III Semester |
| Subject Title | **:** | **FOUNDRY PRACTICAL** |

**TEACHING AND SCHEME OF EXAMINATION:**

No of weeks per semester: 15 weeks

| Subject Title | Instructions | | Examination | | | |
|---|---|---|---|---|---|---|
| | Hours /Week | Hours /Semester | Marks | | | Duration |
| | | | Internal Assessment | Board Examination | Total | |
| Foundry Practical | 4 Hrs | 15 X 4 = 60 Hrs | 25 | 75 | 100 | 3 Hrs |



**RATIONALE:**

It is very much important to impart basic moulding skills to the Diploma Engineer as it is one of the most important manufacturing processes.

They should be given training to prepare moulding sand. Training should be given to use all types of tools to make a Green sand mould. They should be trained to prepare cores using various processes. In this lab they are exposed to various practical aspects relevant to manual moulding.

**GUIDELINES:**

- All the experiments given in the list of experiments should be completed and given for the end semester practical examination.
- In order to develop best skills in handling Instruments/Equipment and taking readings in the practical classes, every two students should be provided with a separate experimental setup for doing experiments in the laboratory.

- The external examiners are requested to ensure that a single experimental question should not be given to more than four students while admitting a batch of 30 students during Board Examinations.

**ALLOCATION OF MARKS**

| | |
|---|---|
| Procedure | 20 marks |
| Equipment Handling | 20 marks |
| Moulding and Finish | 20 marks |
| Result | 10 marks |
| Viva Voce | 05 marks |
| Total | 75 Marks |

**COMPLETE LIST OF EXPERIMENTS IN DETAIL**

Preparation of Mould using Single Piece Pattern for

1. Cube
2. Rectangle
3. Flange
4. Gear Wheel
5. End Plate
6. Yoke
7. Bearing Top
8. Stepped Pulley



Preparation of Mould using Double Piece Pattern for

9. Bend Pipe
10. Straight Pipe
11. T – Pipe
12. Dumb-Bells
13. Loose-Piece Pattern
14. Cylindrical Core Making
15. $CO_2$ Core Making
16. Preparation of Green sand for Moulding
17. Preparation of Core Sand
18. Oil Core Making
19. Preparing a Casting

## LIST OF EQUIPMENTS

## AND THE QUANTITY REQUIRED FOR A BATCH OF 30 STUDENTS

| | | |
|---|---|---|
| 1. | Moulding Boxes | 15 sets |
| 2. | Striker Bar | 15 |
| 3. | Peen Rammer | 15 |
| 4. | Round Rammer | 15 |
| 5. | Trowel | 15 |
| 6. | Lifter / Cleaner | 15 |
| 7. | Vent Rod | 15 |
| 8. | Sprue Pin | 30 |
| 9. | Water Bucket | 5 |
| 10. | Sand Muller | 1 |
| 11. | Dross spike | 15 |

DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN METALLURGY

II YEAR

M SCHEME



III SEMESTER

2015 -2016 onwards

**30001 - COMPUTER APPLICATIONS PRACTICAL ****

CURRICULUM DEVELOPMENT CENTRE

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU.**

**DIPLOMA IN COMPUTER ENGINEERING**

**M- SCHEME**

( to be implemented for the student Admitted from the Year 2015-2016 on wards)

(Implemented from the academic year 2016-2017 onwards)

Course Name : For All Branches

Subject Code : 30001

Semester : III

Subject title : COMPUTER APPLICATIONS PRACTICAL

**TEACHING & SCHEME OF EXAMINATION:**

No. of weeks per Semester: 15 Weeks

| Course | Instruction | | Examination | | | |
|---|---|---|---|---|---|---|
| | | | Max. | | | Duration |
| | Hours/ week | Hours/ Semester | Internal Assessment | Board Examination | Total | |
| COMPUTER APPLICATIONS PRACTICAL | 4Hrs | 60 Hrs | 25 | 75 | 100 | 3Hrs |



**RATIONALE:**

The application of Computer knowledge is essential the students of all disciplines of Engineering in addition to their respective branch of study. The Computer Application Practical course facilitates the necessary knowledge and skills regarding creating, working and maintaining the documents and presentation of documents with audio visual effects ina computer and produces necessary skills in E- Learning and Chatting tools..

**OBJECTIVES:**

On completion of the following exercises, the students will be able to

- Use the GUI operating systems
- Familiarize and customize the desktop
- Use the different facilities available in the word processor
- Prepare Power Point presentation with different formats
- Expose E-learning tools and chatting tools
- Analyze the datasheet
- Create and manipulate the database
- Create different types of charts
- Prepare PowerPoint presentation

- Understand Internet concepts and usage of e-mail

**GUIDELINES:**

- All the experiments given in the list of experiments should be completed and all the experiments should include for the end semester practical examination.
- The computer systems should be 1:1ratioforpracticalclasses

## SYLLABUS
## LAB EXERCISES
## SECTION – A

**GRAPHICAL OPEARTING SYSTEM**

Introduction to GUI OS; Features and various versions of GUI OS & its use; Working with GUI OS; My Computer & Recycle bin ; Desktop, Icons and Explorer; Screen description & working styles of GUI OS; Dialog Boxes & Toolbars; Working with Files & Folders; simple operations like copy, delete, moving of files and folders from one drive to another, Shortcuts &Autostart; Accessories and Windows Settings using Control Panel- setting common devices using control panel, modem, printers, audio, network, fonts, creating users, internet settings, Start button & Program lists; Installing and Uninstalling new Hard ware & Software program on your computer - Copying in CD/DVD settings – Recording Audio files.



**Exercises**

1. a. Installing screen saver and change the monitor resolution by 1280X960
   b. Setting wall papers
   c. Creating, moving, deleting and renaming a folder
   d. Copy, paste and cut a folder/file
   e. Displaying the properties for a file or folder
2. a. Restoring files and folders from Recycle bin
   b. Creating short cuts for folder/file
   c. Finding a file or folder by name
   d. Selecting and moving two or more files/folders using mouse
   e. Sorting folders/files.

**WORD PROCESSING**

Introduction to Word Processing – Examples- Creation of new documents, opening document, insert a document into another document. Page setup, margins, gutters, font properties, Alignment, page breaks, header footer deleting, moving, replace, editing text in document. Saving a document, spell checker.

Printing a document. Creating a table, entering and editing, Text in tables. Changing format of table, height width of row or column. Editing, deleting Rows, columns in table. Borders, shading, Templates, wizards, drawing objects, mail merge.

**Exercises**

3. Create the following table and perform the operations given below

| DAYS | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| MON | ⟵TEST⟶ | | **A**: JPP | | CA | RDBMS | TUT | |
| | | | **B**:RDBMS | | | | | |
| TUE | CA | OOP | CN | RDBMS | **A**: RDBMS | | | |
| | | | | | **B**: JPP | | | |
| WED | CN | RDBMS | OOP | RDBMS | COMMUNICATIO N | | CN | CA |
| THU | OOP | **A**: JPP | | | CA | RDBMS | CN | OOP |
| | | **B**: RDBMS | | | | | | |
| FRI | COMMUNICATI ON | | **A**: RDBMS | | OOP | CN | RDBMS | CA |
| | | | **B**: JPP | | | | | |
| SAT | OOPS | RDBMS | CN | CA | --------- | | | |

4. Create a standard covering letter and use mail merge to generate the customized letters for applying to a job in various organizations. Also, create a database and generate labels for the applying organizations.

5. Create a news letter of three pages with two columns text. The first page contains some formatting bullets and numbers. Set the document background colour and add 'confidential' as the watermark. Give the document a title which should be displayed in the header. The header/ footer of the first page should be different from other two pages. Also, add author name and date/ time in the header. The footer should have the page number.



## SPREADSHEET

Introduction to Analysis Package – Examples - Concepts of Workbook & Worksheets; Using Wizards; Various Data Types; Using different features with Data, Cell and Texts; Inserting, Removing & Resizing of Columns & Rows; Working with Data & Ranges; Different Views of Worksheets; Column Freezing, Labels, Hiding, Splitting etc.; Using different features with Data and Text; Use of Formulas, Calculations & Functions; Cell Formatting including Borders & Shading; Working with Different Chart Types; Printing of Workbook & Worksheets with various options.

### Exercises

6. Create a result sheet containing Candidate's Register No., Name, Marks for six subjects. Calculate the total and result. The result must be calculated as below and failed candidates should be turned to red.

   Result is Distinction if Total >= 70 %

   First Class if Total > = 60 % and < 70 %

   Second Class if Total >= 50 % and < 60 %

Pass if Total >= 35 % and < 50 %

Fail otherwise

Create a separate table based on class by using auto filter feature.

7. Create a table of records with columns as Name and Donation Amount. Donation amount should be formatted with two decimal places. There should be at least twenty records in the table. Create a conditional format to highlight the highest donation with blue color and lowest donation with red colour. The table should have a heading.

8. Create line and bar chart to highlight the sales of the company for three different periods for the following data.

**SALES BAR CHART**

| Period | Product1 | Product2 | Product3 | Total |
|---|---|---|---|---|
| JAN | 35 | 40 | 50 | 125 |
| FEB | 46 | 56 | 40 | 142 |
| MAR | 70 | 50 | 40 | 160 |

## SECTION – B

### DATABASE

Introduction – Menus – Tool bar – Create – Edit – Save – Data types – Insert – Delete – Update – View – Sorting and filtering – Queries – Report – Page setup – Print.

**Exercises**



9. Create Database to maintain at least 10 addresses of your class mates with the following constraints

- Roll no. should be the primary key.
- Name should be not null

10. create a students table with the following fields: Sr.No, Reg. No, Name, Marks in 5 subjects. Calculate total and percentage of 10 students. Perform the following queries.

- To find the details of distinction student
- To find the details of first class students
- To find the details of second class students

11. Design a report for the above exercise to print the consolidated result sheet and mark card for the student.

### PRESENTATION

Introduction - Opening new presentation, Parts of PowerPoint window – Opening -Saving and closing presentations - Features of PowerPoint, Background design, Word art, Clip art, Drawings,3D settings - Animations, Sound, Views, types of views - Inserting and deleting slides, arranging slides, slides show, rehearsal, setup show, custom show - Creating custom presentations, action setting, auto content wizard, working with auto content wizard

**Exercises**

12. Make a marketing presentation of any consumer product with at least 10 slides. Use different customized animation effects on pictures and clip art on any four of the ten slides.
13. Create a Presentation about our institution or any subject with different slide transition with sound effect.

**INTERNET**

Introduction – Getting acquainted with Internet Connection - Browsers – Website URL - Open a website – Net Browsing - Email: Creating E-mail id – Sending , receiving and deleting E-mail - Email with Attachments – CC and BCC - Chatting – Creating Group mail - Google docs – Search Engines – Searching topics .

**Most Popular Social Networking Sites :** History – Features – Services – Usage of Face book , Twitter and Linkdln.

Transferring data through wifi / bluetooth among different devices.

**Introduction to cybercrime** – Software Piracy – Viruses – Antivirus Software

**Exercises**

14. Create an e-mail id and perform the following
    - Write an e-mail inviting your friends to your Birthday Party.
    - Make your own signature and add it to the e-mail message.
    - Add a word attachment of the venue route
    - Send the e-mail to at least 5 of your friends.



15. Create a presentation on Google docs. Ask your friend to review it and comment onit. Use "Discussion" option for your discussions on the presentation.

**Hardware and Software Requirements**

**Hardware Requirements:**

- Computers – 36Nos
    - Intel Core i3 Processor
    - 500 GB Hard Disk, 2 MB RAM
    - 14” Monitor
- Projector – 1 Nos
- Laser Printer – 1 No
- Internet Connection – Minimum of 512 KB

**Software Requirement**

- Any GUI Operating System
- Open Source Software / MS- Office

1. SemesterEndExamination–75 Marks

| Content | Max.Marks |
|---|---|
| Writing Procedure – One Question from Section A | 15 |
| Demonstration | 15 |
| Results with Printout | 5 |
| Writing Procedure – One Question from Section B | 15 |
| Demonstration | 15 |
| Results with Printout | 5 |
| Viva voce | 5 |
| Total | **75MARK** |

# IV SEMESTER

DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN METALLURGY

II YEAR

M SCHEME

IV SEMESTER

2015 -2016 onwards



# 32641 - HEAT TREATMENT OF METALS AND ALLOYS

CURRICULUM DEVELOPMENT CENTRE

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**

**DIPLOMA IN METALLURGY**
**M-SCHEME**
**(To be implemented to the student admitted from the Year 2015-2016 on wards)**

Course Name : DIPLOMA IN METALLURGY
Course Code : 1026
Subject Code : **3**2641
Semester : IV Semester
Subject Title : **HEAT TREATMENT OF METALS AND ALLOYS**

**TEACHING AND SCHEME OF EXAMINATION:**

No of weeks per semester: 15 weeks

| Subject Title | Instructions | | Examination | | | |
|---|---|---|---|---|---|---|
| | Hours /Week | Hours /Semester | Marks | | | Duration |
| | | | Internal Assessment | Board Examination | Total | |
| Heat Treatment Of Metals And Alloys | 5 Hrs | 15 x 5 = 75 Hrs | 25 | 75 | 100 | 3 Hrs |



**Topics and Allocation of Hours:**

| Unit No | Topic | Time(Hrs) |
|---|---|---|
| I | Steel Region of the Iron-Carbon Phase Diagram and Hardenability. | 14 |
| II | Annealing, Normalizing, Hardening and Tempering Processes. | 14 |
| III | Oxidation, Decarburization of steels and remedy. Finishing operations after heat treatment and Control of heat treating processes. | 14 |
| IV | Heat treatment of Rolled Products, Wires, Steel and Iron Castings. Heat treatment of forgings of shafts and axles, Springs and Gears | 13 |
| V | Heat treatment of Copper, Aluminium and Magnesium base alloys. | 13 |
| | Revision and Test | 7 |
| TOTAL | | 75 |

**RATIONALE:**

Heating plays an important role in improving the properties of steel, non ferrous metals and to some extent in cast iron. By using this heating and controlled cooling can improve the properties like hardness, strength, ductility and elongation significantly.

The syllabus for heat treatment is designed such that the student knows the basic processes in HT in first 2 units. He also knows the basic problems in processes in the 3rd unit. In the fourth and fifth units the students are prepared to know how the various properties in the ferrous and non ferrous can be improved.

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**OBJECTIVES:**

At the end of the study of III Semester the student will be able to

- To learn about the Steel Region of the Iron-Carbon Phase Diagram
- To know about the Isothermal transformation
- To know about the Hardenability, Cooling Media, Austempering and Martempering
- To know about the Annealing, Normalising, Hardening and Tempering Processes.
- To know about the different Case Hardening Processes
- To know about the Oxidation of steel, Decarburisation of steels and remedy
- To know about the Finishing operations after heat treatment and Control of heat treating processes.
- To know about the Heat treatment of Rolled Products, Wires, Steel and Iron Castings.
- To know about the Heat treatment of forgings of shafts and axles, Springs and Gears.
- To know about the Heat treatment of Copper base alloys.
- To know about the Heat treatment of Aluminium base alloys.
- To know about the Heat treatment of Magnesium base alloys.

## 32641- HEAT TREATMENT OF METALS AND ALLOYS

DETAILED SYLLABUS

Contents: Theory

| Unit | Name of the Topic | Hours |
|---|---|---|
| I | **STEEL REGION OF THE IRON-CARBON PHASE DIAGRAM AND HARDENABILITY.**<br>Introduction to Heat Treatment<br>Heat Treatability<br>The Constitution and structure of Iron-Carbon alloys.<br>Classification of Steels: Plain carbon steels - Their characteristics & limitations.<br>Alloy Steels - Their characteristics and applications.<br>Iron - carbon phase diagram – steel region only.<br>Phase transformation during heating of 0.2% C Steels<br>Phase transformation during heating of 0.6% C Steels<br>Phase transformation during heating of 0.8% C Steels<br>Phase transformation during heating of 1.0% C Steels<br>Phase transformation during cooling of 0.2% C Steels<br>Phase transformation during cooling of 0.6% C Steels<br>Phase transformation during cooling of 0.8% C Steels<br>Phase transformation during cooling of 1.0% C Steels<br>Isothermal transformation<br>Time Temperature - Transformation diagram - applications. (TTT diagram of 0.8%C steel)<br>Cooling curves<br>Decomposition of Austenite to Pearlite<br>Decomposition of Austenite to Martensite<br>Hardenability - Jominey end Quench Test - Cooling Media<br>Austempering - Martempering | 14 |
| II | **ANNEALING, NORMALIZING, HARDENING AND TEMPERING PROCESSES.**<br>Annealing: Classification, Purpose, Full annealing, Isothermal annealing, Process annealing, Partial annealing Diffusion annealing, Spheroidizing, Re-crystallisation annealing, Applications, Normalizing, Comparison with annealing, Applications, Hardening by Quenching, Retained Austenite, Sub-zero treatment, Tempering, 3 stages of tempering, Temper colours, Temper brittleness, Case Hardening, Classification, Surface hardening, Flame hardening, Induction hardening, Chemical hardening – Carburisation, Pack Carburisation, Liquid Carburisation, Gas Carburisation, Nitriding, Carbonitriding, Cyaniding. | 14 |

| | | |
|---|---|---|
| **III** | **OXIDATION, DECARBURISATION OF STEELS AND REMEDY. FINISHING OPERATIONS AFTER HEAT TREATMENT AND CONTROL OF HEAT TREATING PROCESSES.**<br><br>Oxidation of steel, Means of preventing steel from oxidation, Decarburisation of steels, Means of preventing steels from decarburisation, Finishing operations after heat treatment, Removal of scales, Alkaline detergent cleaning process. Straightening process, Control of heat treating process, Incoming steel inspection, Quality control of heat treated component. | **14** |
| **IV** | **HEAT TREATMENT OF ROLLED PRODUCTS, WIRES, STEEL AND IRON CASTINGS. HEAT TREATMENT OF FORGINGS OF SHAFTS, AXLES, SPRINGS AND GEARS.**<br><br>Heat treatment of hot rolled steel, Heat treatment of cold rolled steel, Heat treatment of wires, Heat treatment of steel castings, Heat treatment of grey cast iron, Heat treatment of white cast iron, Heat treatment of S.G. iron , Heat treatment of forgings of shafts and axles, Heat treatment of springs, Heat treatment of gears | **13** |
| **V** | **HEAT TREATMENT OF COPPER, ALUMINUM AND OF MAGNESIUM BASE ALLOYS.**<br><br>Heat treatment of Copper base alloys, Heat treatment of Copper, Heat treatment brass, Heat treatment of bronze. Heat treatment of Aluminium base alloys, Heat treatment of wrought Aluminium alloys, Heat treatment of Aluminium alloy castings, Heat treatment of Magnesium base alloys | **13** |



**Text Book:**

1. Heat Treatment of Metals, Vijendra Singh, Standard Publishers Distributers, Delhi.
2. Heat treatment : Principles and Techniques, T.V.Rajan, C.P.Sharma and Ashok Sharma. Prentice Hall of India Pvt Ltd., New Delhi - 1988.

**Reference Book:**


1. Engineering Physical Metallurgy by Lakhtin, MIR publications.
2. Heat Treatment of Metals and Alloys, Zakharov, MIR Publication.
3. Handbook of Heat Treatment of Steels, Prabhudev K H., Tata - McGraw Hill Publishing Co. New Delhi. 1988.
4. Theory of Heat Treatment of Metals, Novikov .I., MIR Publishers. Moscow. 1978
5. Steel and its heat treatment, Thelning K.E., Bofors handbook, 1975


**Hand Book:**


1. Hand Book on Heat Treatment Vol.4, ASM Metals Parks. Ohio. USA. 1991




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DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN METALLURGY

II YEAR

M SCHEME

IV SEMESTER

2015 -2016 onwards



**32642 – NON–FERROUS EXTRACTIVE METALLURGY**

CURRICULUM DEVELOPMENT CENTRE

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**

**DIPLOMA IN METALLURGY**
**M-SCHEME**
**(To be implemented to the student admitted from the Year 2015-2016 on wards)**

Course Name : DIPLOMA IN METALLURGY
Course Code : 1026
Subject Code : **3**2642
Semester : IV Semester
Subject Title : **NON-FERROUS EXTRACTIVE METALLURGY**

**TEACHING AND SCHEME OF EXAMINATION:**

No of weeks per semester: 15 weeks

| Subject Title | Instructions | | Examination | | | |
|---|---|---|---|---|---|---|
| | Hours /Week | Hours /Semester | Marks | | | Duration |
| | | | Internal Assessment | Board Examination | Total | |
| Non-Ferrous Extractive Metallurgy | 5 Hrs | 15 X 5 = 75 Hrs | 25 | 75 | 100 | 3 Hrs |



**Topics and Allocation of Hours:**

| **Unit No** | Topic | Time(Hrs) |
|---|---|---|
| I | Extraction of Copper | 14 |
| II | Extraction of Aluminium | 14 |
| III | Extraction of Magnesium | 14 |
| IV | Extraction of Lead and Tin | 13 |
| V | Extraction of Zinc and Precious Metals | 13 |
| | Revision and Test | 7 |
| TOTAL | | 75 |

**RATIONALE:**

Engineering and Non- engineering applications requires components made up of Metals with required properties. The metals are broadly classified as Ferrous and Non-ferrous metals.

The Minerals and their occurrence, Extraction methods and refining methods should be studied. This subject deals with basics of Extractive Metallurgy. The minerals, important ores and their Locations of Important Non-ferrous metals and their uses are studied in this subject. It also deals with the methods of extraction and refining of industrially and commercially important Non-ferrous metals..

**OBJECTIVES:**

At the end of the study of III Semester the student will be able to

- Know about copper ores and their occurrence
- Know about methods of extraction of copper.
- Know about Aluminium ores and their occurrence
- Know about methods of extraction of Aluminium.
- Know about magnesium ores and their occurrence.
- Know about methods of extraction of magnesium.
- Know about lead and tin ores and their occurrence
- Know about methods of extraction of tin and lead.
- Know about zinc ores, precious metals and their occurrence
- Know about methods of extraction of zinc and precious metals.

## 32642. NON-FERROUS EXTRACTIVE METALLURGY

DETAILED SYLLABUS

Contents: Theory

| Unit | Name of the Topic | Hours |
|---|---|---|
| I | **EXTRACTION OF COPPER :**<br>Production of copper: Introduction to copper - types of copper ores - concentration - occurrence - Nature of copper ores - Pyrometallurgical - Roasting - Smelting – Converting - refining extraction of copper.<br>Hydro metallurgical extraction of copper. | 14 |
| II | **EXTRACTION OF ALUMINIUM :**<br>Production of Aluminium: Introduction to Aluminium - Aluminium ores and their occurrences - extraction of Aluminium from ore - purification of bauxite - calcination - reduction of alumina - Hall-Heroult process – factors affecting Bayer's process - factors influencing Hall-Heroult process – Mechanism of Hall Heroult process Refining of Aluminium | 14 |
| III | **EXTRACTION OF MAGNESIUM :**<br>Production of Magnesium - Introduction to magnesium - Magnesium ores - Extraction of magnesium from seawater - Pidgeon process - Magnotherm process - Mechanism of Pidgeon process - Energy Calculations<br>- NML Process, CECRI Process | 14 |
| IV | **EXTRACTION OF TIN AND LEAD**<br>Production of tin: Introduction to tin - tin ores - tin extraction - smelting – refining - tin alloys and uses.<br>Production of lead: Introduction to lead - Lead ores –<br>Extraction of lead from its ores | 13 |
| V | **EXTRACTION OF ZINC AND PRECIOUS METALS**<br>Production of zinc: Introduction to zinc - Zinc ores –<br>Pyrometallurgical extraction of Zinc –<br>Hydro metallurgical Extraction of zinc,<br>Production of gold: Amalgamation, Chlorination, Cyanidation,<br>Production of Silver: Chlorination, Cyanidation, Product recovery,<br>Extraction of platinum group of metals. | 13 |

**Text book**

1. Extraction of Non Ferrous Metals, H.S. Ray, R.Sridhar & K.P.Abraham, East - West Press Pvt Ltd, New Delhi.
2. Principles of Non-ferrous Extractive Metallurgy, Ray. H S and Ghosh.A, Prentice Hall of India. New Delhi. 1994.

**Reference Books**


1. Elements of Metallurgy, Dr.Swarup & Dr.Saxena, Rastogi Publications, Meerut.
2. Metallurgy of Non-Ferrous Metals, W.H. Dennis, Ditman, London
3. Extraction Metallurgy, Gilchrist, Pergamon Press, London.
4. Extractive Metallurgy, Newton, Willey Eastern, New Delhi.
5. Extraction of Non-ferrous Metals, Ray .H S, Eastern Law House. India. 1994.
6. Unit Processes in Extractive Metallurgy, Pehlke.R D., American Elsevier Publishing Co.. New York. USA. 1993.
7. Principles of Extractive Metallurgy, Terkel Rosenqvist, 2nd ed. McGraw-Hill International Book Co. London. 1983.
8. Non Ferrous Metallurgy, Sevryukov.N. 1975. Mir. Moscow.

DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN METALLURGY

II YEAR

M SCHEME

IV SEMESTER



2015 -2016 onwards

**32643 – METAL JOINING**

CURRICULUM DEVELOPMENT CENTRE

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**

**DIPLOMA IN METALLURGY**
**M-SCHEME**
**(To be implemented to the student admitted from the Year 2015-2016 on wards)**

Course Name : DIPLOMA IN METALLURGY
Course Code : 1026
Subject Code : **3**2643
Semester : IV Semester
Subject Title : **METAL JOINING**

**TEACHING AND SCHEME OF EXAMINATION:**

No of weeks per semester: 15 weeks

| Subject Title | Instructions | | Examination | | | |
|---|---|---|---|---|---|---|
| | Hours /Week | Hours /Semester | Marks | | | Duration |
| | | | Internal Assessment | Board Examination | Total | |
| Metal Joining | 5 Hrs | 15 X 5 = 75 Hrs | 25 | 75 | 100 | 3 Hrs |



**Topics and Allocation of Hours:**

| **Unit No** | Topic | Time(Hrs) |
|---|---|---|
| I | Welding Process & Equipments, power sources | 14 |
| II | Arc welding Processes & Equipments | 14 |
| III | Gas Welding, Welding techniques , equipments | 14 |
| IV | Welding Metallurgy, , brazing & soldering methods | 13 |
| V | Welding defects, jigs & fixtures, testing & safety | 13 |
| | Revision and Test | 7 |
| TOTAL | | 75 |

**RATIONALE:**

Welding is a process to join metals of different types. Welding process have become increasing the important in almost all manufacturing industries and for structural fabrication. Ship building thermal and nuclear power plant, oil pipeline, construction and automobile are the major industries whereas welding employed extensively. In first 3 units different types of welding processes, procedure, principles etc. In $4^{th}$ and $5^{th}$ unit the metallurgy of welding like heat flow, microstructure, weldability ,symbols, defects, welding safety recommendation and using of jigs and fixtures etc.

By studying this subject the student can able to understand the real conditions and use the right type of process and remedies to particular operations.

**OBJECTIVES:**

At the end of the study of III Semester the student will be able to

- Understand welding principles
- Difference from other processes
- Various aspects of arc welding will be understood
- Specialized arc welding equipments will be taught
- Basics of gas welding on metals will be understood
- Fundamentals of Brazing & Soldering is dealt
- Gas welding and Cutting are dealt
- Metallurgy of welding will be effective in controlling the variables & processes
- Fundamentals of HAZ & microstructures will be useful
- Types of Jigs & Fixtures are discussed
- The common welding defects are analyzed with their remedial measures
- Welding symbols are indicated
- Testing of Weldments is taught which is a control routine in quality control
- Safety recommendations & Protection to the welders & equipments will be useful in improving the quality of component & human.

## 32643. METAL JOINING

DETAILED SYLLABUS

Contents: Theory

| Unit | Name of the Topic | Hours |
|---|---|---|
| I | **WELDING PROCESS & EQUIPMENTS, POWERSOURCES :**<br><br>**Welding processes**: Introduction to welding. Welding as fabrication Over other manufacturing process Welding terms and characteristics<br><br>**Arc welding** –Introduction to arc welding- Equipments -Arc welding power sources-selection factors for power sources-DC power sources-AC-DC rectifiers-AC power sources-AC generators- AC transformers.<br><br>**Other equipments and accessories**. Welding electrodes- Types of electrodes- Electrode coatings-functions of coatings- Coating ingredients-Classifications of coatings- Selection of electrodes.<br>Care and storage of electrodes-Coding of mild steel and low alloy steels electrodes. (Indian system only)<br><br>**Arc welding process**- Arc initiation-Electrode polarity and its effects. | 14 |
| II | **SPECIAL WELDING PROCESSES & ITS EQUIPMENTS**<br><br>Flux shielded metal arc welding.(principle, operation, equipment, advantages & disadvantages, use only),<br>Avoiding crater on main structure. Procedure for restarting arc with a new electrode.<br>Submerged arc welding process.(principle, operation, equipment, advantages &dis advantages, use only)<br>Single carbon arc welding. (Principle, operation, equipment, advantages & disadvantages, use only)<br>Thermit welding (principle, operation, equipment, advantages & disadvantages, use only)<br>Tungsten inert gas welding. (Principle, operation, equipment, adv & disadvantages, use only)<br>Plasma arc welding.(principle, application only)<br>Electron beam welding.(principle, application only)<br>Laser welding. (Principle, application only). | 14 |

| | | |
|---|---|---|
| III | **GAS WELDING & EQUIPMENTS**<br><br>**Oxy-Acetylene welding:** Principle of operation- Types of welding flames - Chemistry of oxy-acetylene flame- Lightning, adjusting and extinguish the flame.<br>**Gas welding techniques**- leftward technique-rightward technique- Filler metal- fluxes- Machines and accessories –<br>**Gas welding equipments**- Oxygen gas cylinder- Acetylene gas cylinder- Acetylene gas generator- Manifold system for gas welding- Oxygen and acetylene pressure regulators- Comparison. Oxygen and acetylene gas hoses and hose connections- Welding torches (two types) Welding nozzles- Gas lighter- Gas cylinder trolleys. | **14** |
| IV | **WELDING METALLURGY, BRAZING & SOLDERING :**<br><br>**Welding Metallurgy:-** Introduction- General considerations- Solidification of the weld metal- Gas- metal reactions- Slag- metal reactions- Hot – cracking- Weld composition.<br>**Heat flow in welding**:- Various zones of a welded component- Thermal diffusivity- Temperature distribution- Temperature – time curve-Under bead cracking- Weldability-Carbon equivalent.<br>**Braze welding, brazing, soldering**: Definition and comparison- advantages and limitations - Procedure for braze welding Soldering-definition Principles of good soldering process-Metallurgy of brazing and soldering. | **13** |
| V | **WELDING DEFECTS, TESTING & SAFETY :**<br><br>**Defects in welds-** Cracks-Incomplete penetration- Porosity & blowholes -Poor weld bead appearance- Undercutting - Distortion Inclusions – Poor fusion - Spatter - Overlapping.<br>**Introduction to metal cutting:-**Types of cutting processes-Oxy – fuel ga cutting- flame cutting-Advantage- disadvantage and uses.<br>**Welding jigs and fixtures** .introduction –types<br>**Welding symbols**:- Representing the welds-Basic weld symbols - Location of welds-Supplementary symbols -Dimensions of welds.<br>**Testing of welds:-**<br>**Hardness test:-**<br>Brinell hardness test-.Rockwell hardness test.-Vickers hardness & Micro Hardness test.<br>**Safety recommendations gas welding equipment** – Gas cylinders- Manifolds-Torches and tips Pressure regulators -Gas tubing Other general precautions.<br>**Safety recommendations for arc welding equipments**— Arc welding machines- Electrode holders - Explosion- fire and other hazards-Protectio of welders.- Protection from welding rays -Protection from sparks and spatter- Ventilation and health protection. | **13** |

**Text Book:**

1. A text book of Welding technology, O.P.Khanna, Dhanpat Rai & Sons.
2. Welding Technology, N.K.Srinivasan, Khanna Publishers

**Reference Books:**


1. Welding and Brazing, ASM Metals hand Book, Vol.6, Ohio.
2. AWS Handbook.
3. Modern Arc welding technology, S.V.Nadkarni, Oxford & IBH Pub, New Delhi.
4. Modern Arc welding technology, Howard B.Cary, Prentice Hall Inc, USA.
5. Welding and Welding Technology, Richard L.Little,
   Tata McGraw Hill Publishing Co Ltd.
6. Metallurgy of Welding, Lancecaster JF, George Allen Co, Boston.

DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN METALLURGY

II YEAR

M SCHEME

IV SEMESTER

2015 -2016 onwards



**32644 – PRODUCTION OF STEEL**

CURRICULUM DEVELOPMENT CENTRE

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**

**DIPLOMA IN METALLURGY**
**M-SCHEME**
**(To be implemented to the student admitted from the Year 2015-2016 on wards)**

Course Name : DIPLOMA IN METALLURGY
Course Code : 1026
Subject Code : **3**2644
Semester : IV Semester
Subject Title : **PRODUCTION OF STEEL**

**TEACHING AND SCHEME OF EXAMINATION:**

No of weeks per semester: 15 weeks

| Subject Title | Instructions | | Examination | | | |
|---|---|---|---|---|---|---|
| | Hours /Week | Hours /Semester | Marks | | | Duration |
| | | | Internal Assessment | Board Examination | Total | |
| Production of Steel | 5 Hrs | 15 X 5 = 75 Hrs | 25 | 75 | 100 | 3 Hrs |



**Topics and Allocation of Hours:**

| Unit No | Topic | Time(Hrs) |
|---|---|---|
| I | Introduction, Raw material, principles of Steel making | 14 |
| II | Conventional process - Bessemer , Open hearth | 14 |
| III | Modern steel making – Basic Oxygen steel making | 14 |
| IV | Continuous casting , Vacuum treatment | 13 |
| V | Ingot mould , types, defects, steel classifications & specifications. | 13 |
| | Revision and Test | 7 |
| TOTAL | | 75 |

**RATIONALE:**

Steel is not any specific product. It is a malleable alloy of iron and other elements like C, Cr, Ni, Si, V, W, etc. There are as many as few thousand varieties of steel in use. They are specifically differing in chemical composition. Other than the some impurities like Al, Si, Mn, S, P, O, etc are present. To minimize them during steel making process some special techniques are required all those things i.e., various methods of steel making such as solidification mechanism, degassing treatment are studied under this subject.

**OBJECTIVES:**

At the end of the study of III Semester the student will be able to

- Raw material for steel making & its types.
- Slag properties- acid, basic slags.
- Oxygen steel making process- LD, Kaldo & Rotor.
- Learn about the freezing of Ingot & ingot defects.
- Learn about the degassing principles and equipments used for degassing.
- Study about the Cast iron & its types.
- Study of production of Cast irons and its properties.
- To impart knowledge about continuous casting processes & types
- To provide details about steel specifications.

## 32644. PRODUCTION OF STEEL

DETAILED SYLLABUS

Contents: Theory

| Unit | Name of the Topic | Hours |
|---|---|---|
| I | **INTRODUCTION, RAW MATERIAL, PRINCIPLES OF STEEL MAKING**<br><br>Steel making introduction**-** an out line of various methods of steel making<br>**Raw materials for steel making** (sources of steel, heat, oxidizer, deoxidizer, alloying elements, flux, refractories).<br>Deoxidation- comparison deoxidizing effects of various deoxidizers<br>**Types of slag** & oxides – basics- refining slag-thermodynamics and kinetics of refining | **14** |
| II | **CONVENTIONAL PROCESS - BESSEMER , OPEN HEARTH**<br><br>**Acid Bessemer process & Basic Bessemer process - Side blown converter**<br>Open hearth steel making-furnace construction-acid open hearth practice - basic open hearth process-different slag practices-duplexing-oxygen enrichment of fuel | **14** |
| III | **MODERN STEEL MAKING – BASIC OXYGEN STEEL MAKING :**<br><br>Principles of oxygen steel making. Basic oxygen furnace (BOF) steel making process by LD process-plant and equipment-Kaldo process -Rotor processes. oxygen bottom blowing process of steel making.<br>Manufacture of steel by Electric Arc furnace process. | **14** |

| | | |
|---|---|---|
| **IV** | **CONTINUOUS CASTING, VACUUM TREATMENT OF STEELS :**<br>Continuous Casting: Introduction, Principle, Types- Vertical ,<br>Vertical mould horizontal discharge, Curved mould (S-type)<br>Introduction to clean steel by degassing –<br>Gases dissolved in steel: Oxygen, Hydrogen, and Nitrogen.<br>Effect of these on quality of steel.<br>Basic principles of degassing.<br>Ladle degassing, Gas stirring, Gas stirring and Arc heating<br>Induction stirring, Induction stirring Arc heating<br>Mould degassing<br>Stream degassing<br>Ladle to Mould degassing, Ladle to ladle degassing<br>TAP degassing process,<br>GERO Vacuum degassing process<br>THERM-I-VAC degassing process, Circulation degassing<br>R-H degassing and, D-H degassing processes | **13** |
| **V** | **INGOT MOULD, TYPES, DEFECTS, STEEL CLASSIFICATIONS & SPECIFICATIONS :**<br>Ingot solidification: Freezing of Ingots - structure<br>Types of steels according to degassing using de-oxidizers like Silicon and Aluminium<br>Killed steels<br>Semi-killed steels<br>Rimming steels and<br>Capped steels.<br>Ingot defects & remedies: Pipe, Blow Holes, Ingotism, Segregation, and Non-metallic inclusions.<br>Steel specification according to Indian standard and AISI/SAE standards only. | **13** |



**TEXT BOOK :**

1. Introduction to Modern Steel Making, Tupkary,R.H.,
Khanna Publications, New Delhi, 5th edition, reprinted, 1994.
2. Iron Making and Steel Making, Theory and Practice,
Abindra Ghosh and Amit chatterjee,
Prentice Hall of India Private Ltd., New Delhi 2008.

**REFERENCES :**

1. The Making, Shaping and Treating of Steel, Fruehan.R.J,
AISE Steel Foundation, edition 11, 1998.
2. Manufacture of Iron and Steel, Bashforth, GR, Vol 2, third edition,
Chapman & Hall, London, 1964.
3. Steel making, Chakrabarti.A.K., Printice-Hall of India, New Delhi, 2007

DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN METALLURGY

II YEAR

M SCHEME

IV SEMESTER

2015 -2016 onwards



**32645 – CAD in METALLURGY PRACTICAL**

CURRICULUM DEVELOPMENT CENTRE

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**

**DIPLOMA IN METALLURGY**
**M-SCHEME**
**(To be implemented to the student admitted from the Year 2015-2016 on wards)**

Course Name : DIPLOMA IN METALLURGY
Course Code : 1026
Subject Code : **3**2645
Semester : IV Semester
Subject Title : **CAD in METALLURGY PRACTICAL**

**TEACHING AND SCHEME OF EXAMINATION:**

No of weeks per semester: 15 weeks

| Subject | Instructions | | Examination | | | |
|---|---|---|---|---|---|---|
| | Hours/ Week | Hours/ Semester | Marks | | | Duration |
| CAD in Metallurgy Practical | 6 | 6 x 15 = 90 Hrs. | Internal Assessment | Board Examination | Total | 3 Hrs |
| | | | 25 | 75 | 100 | |



**Topics and Allocation of Hours:**

| Unit No | Topics | Hours |
|---|---|---|
| I | INTRODUCTION TO CAD SOFTWARE | 3 |
| II | DRAWING AIDS AND EDITING COMMANDS | 8 |
| III | BASIC DIMENSIONING, HATCHING, BLOCKS AND VIEWS | 8 |
| IV | ISOMETRIC DRAWING, PRINTING AND PLOTTING | 8 |
| V | CAD DRAWING PRACTICE<br>DETAILED DRAWINGS OF FOLLOWING PATTERNS AND MACHINE PARTS ARE GIVEN TO STUDENTS TO ASSEMBLE AND DRAW THE SECTIONAL OR PLAIN ELEVATIONS / PLANS / AND SIDE VIEWS WITH DIMENSIONING AND BILL OF MATERIALS USING CAD SOFTWARE – 15 EXERCISES | 60 |
| | REVISION AND TEST | 3 |
| | TOTAL | **90** |

**RATIONALE:**

The contemporary progressing world is fast with the latest production systems. The advanced manufacturing of products is developed instantly using CAD Software. Even a small scale industry is now using CAD software as it has become the heart of the Design department. So CAD has now become inevitable in industries.

Accuracy and Precision are the two important things that decide the quality of a product to survive its competitors in the market. Using CAD software design, the uniform accuracy, multiples of copies and storing in a small space for long time are assured.

The CAD software considerably improves the creativity and flexibility of a designer. The syllabus here enables a candidate to draw an industrial drawing within the optimum reach of a diploma cadre.

**OBJECTIVES:**

- Appreciate the need of sectional view and types of sections.
- Draw sectional views using different types of sections.
- Practice on CAD commands in making 2D Drawings.
- Draw assembled drawings of different types of joints using CAD.
- Draw assembled drawings of various types of Patterns using CAD.



**BOARD EXAMINATION: Scheme of Examination**

| | |
|---|---|
| **Part A** (Unit 1 to Unit 4)<br>One mark questions (10 out of 15 questions) | **10X1=10** |
| **Part B**(Unit 5)<br>2D Drawing (Front View / Top View) | **30** |
| **Part C**<br>3D Drawing solid modelling<br>Mass Properties | **25**<br>**05** |
| **Viva voce** | **05** |
| **Total** | **75 marks** |

## 32645 – CAD in METALLURGY PRACTICAL

## DETAILED SYLLABUS

**Contents: Theory**

| Unit | Name of the Topic | Hours |
|---|---|---|
| I | **INTRODUCTION TO CAD SOFTWARE**<br><br>Introduction – History of CAD – Applications – Advantages over manual drafting – Hardware requirements – Software requirements – Windows desktop – CAD screen interface – menus – Tool bars – How to start CAD – How to execute command – types of co-ordinate systems – Absolute – Relative – Polar. | 3Hrs |
| II | **DRAWING AIDS AND EDITING COMMANDS**<br><br>Creating objects (2D) – Using draw commands – Line, Arc, Circle, Ellipse, Donut, Polygon, Point, Pline, Sketch, Trace – Creating 2D Solid. Creating text – Dtext, Mtext, Text styles – Mline, spline – Drawing with precision – Osnap options – drafting settings –limits – Units – drawing aids – Fill, Snap, Grid, Ortho lines – Function keys - Editing and modify commands – Object selection methods – Erasing object – Oops - Cancelling and undoing a command – Copy – Move – Array – Offset – Scale – Rotate – Mirror – Break – Trim – Extend – Explode. Divide – Measure – stretch – Lengthen – Changing properties – Color – line types –LT scale – Matching properties – Editing with grips – Pedit – Ddedit – Mledit. | 8Hrs |
| III | **BASIC DIMENSIONING, HATCHING, BLOCKS AND VIEWS**<br>Basic dimensioning – Editing dimensions – Dimension styles – Dimension system variables. Machine drawing with CAD. Creation of blocks – Wblock – inserting a block – Block attributes – Hatching –Pattern types – Boundary hatch – working with layers - Controlling the drawing display – Blipmode – View group commands – Zoom, redraw, regen, regenauto, pan, viewres – Real time zoom. Inquiry groups – calculating area – Distance – Time – Status of drawing – Using calculator. | 8Hrs |
| IV | **ISOMETRIC DRAWING, PRINTING AND PLOTTING**<br>Isometric drawing – Isometric projection – drawing isocircles – Dimensioning isometric objects. File commands – File Import and export – plotting drawing – external references – 3D fundamentals – 2D to 3D Conversion<br><br>3D Drawing : 3D Primitives-Extrude – Revolve-Slice-Section, Surface 3D Mesh-3D - Surface-3D Operation-Solid Editing | 8Hrs |

| | | | |
|---|---|---|---|
| **V** | **CAD DRAWING PRACTICE**<br><br>Detailed drawings of following Patterns and machine parts are given to students to assemble and draw the sectional or plain elevations / plans / and side views with dimensioning and bill of materials using CAD Software | | **60 Hrs** |
| | 2 D – Front View Only<br>1. Sleeve & Cotter joint<br>2. Spigot & Cotter joint<br>3. Gib and Cotter joint<br>4. Stuffing Box-vertical<br>5. Flange coupling-protected type<br>6. Mechanised Foundry Layout<br>7. Iso metric practice | 3D<br>1. Single piece pattern<br>2. Split pattern – two piece<br>3. Split pattern – three piece<br>4. Loose piece pattern<br>5. Sweep pattern<br>6. Follow board pattern<br>7. Segmental pattern<br>8. Bearing Block | |

**Reference Books:**


1. Inside AutoCAD - D. Raker and H. Rice - BPB Publications, NewDelhi
2. Engineering Drawing and Graphics + AutoCAD – K.Venugopal, - New Age International Publications
3. CAD/CAM/CIM - P. Radhakrishnan, S. Subramaniyan and V.Raju – New Age International Publications.
4. AutoCAD 2002 with Applications - Sham Tickoo - Tata Mcgraw Hill.
5. Computer Graphics, Prentice – Donald Hearn, M. Pauline Baker - Hall of India Pvt. Limited, NewDelhi.




**LIST OF EQUIPMENT**

1. Personal computer (With latest processor to suit Auto CAD) – 30 No's

2. MS Windows OS – 30 No's

3. AutoCAD software (release 2000 or above) – 30 Users

DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN METALLURGY

II YEAR

M SCHEME

IV SEMESTER

2015 -2016 onwards



**32646 – HEAT TREATMENT PRACTICAL**

CURRICULUM DEVELOPMENT CENTRE

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**

**DIPLOMA IN METALLURGY**
**M-SCHEME**
**(To be implemented to the student admitted from the Year 2015-2016 on wards)**

| | | |
|---|---|---|
| Course Name | **:** | DIPLOMA IN METALLURGY |
| Course Code | : | 1026 |
| Subject Code | **:** | **3**2646 |
| Semester | **:** | IV Semester |
| Subject Title | **:** | **HEAT TREATMENT PRACTICAL** |

**TEACHING AND SCHEME OF EXAMINATION:**

No of weeks per semester: 15 weeks

| Subject Title | Instructions | | Examination | | | |
|---|---|---|---|---|---|---|
| | Hours /Week | Hours /Semester | Marks | | | Duration |
| | | | Internal Assessment | Board Examination | Total | |
| Heat Treatment Practical | 4 Hrs | 15 X 4 = 60 Hrs | 25 | 75 | 100 | 3 Hrs |



**RATIONALE:**

Heat plays an important role in improving the properties of various components. The students are practically doing the various HT processes, the properties before and after the treatment are compared and the improvement in properties can be analyzed. The various experiments are designed such that the students can know in depth about the improvement in properties by using heat.

**GUIDELINES:**

- All the experiments given in the list of experiments should be completed and given for the end semester practical examination.
- In order to develop best skills in handling Instruments/Equipment and taking readings in the practical classes, every two students should be provided with a separate experimental setup for doing experiments in the laboratory.

- The external examiners are requested to ensure that a single experimental question should not be given to more than four students while admitting a batch of 30 students during Board Examinations.
- For Board practical examination Students are given Heat treated specimens, they have to prepare the specimens for Microstructural analysis and find out the Microstructure and the heat treatment given to it.

**Allocation of Marks Scheme of Examination**

Students are given Heat treated specimens, they have to prepare the specimens for Microstructural analysis and find out the Microstructure and the heat treatment given to it

**Question I :35marks**

Microstructure : 30 marks
Heat treatment : 5 marks

**Question II :35 marks**

Microstructure : 30 marks
Heat treatment : 5 marks

**Viva Voce : 5marks**

**Total : 75marks**



**COMPLETE LIST OF EXPERIMENTS IN DETAIL**

1. Annealing of Low Carbon Steel
2. Annealing of Medium carbon Steel
3. Annealing of High carbon Steel
4. Annealing of Grey Cast Iron
5. Normalizing of Low Carbon Steel
6. Normalizing of Medium Carbon Steel
7. Normalizing of High Carbon Steel
8. Normalizing of Grey Cast Iron

9. Hardening of Medium carbon Steel
10. Hardening of High carbon Steel
11. Tempering of Medium carbon Steel
12. Tempering of High carbon Steel

**LIST OF EQUIPMENTS**

**AND THE QUANTITY REQUIRED FOR A BATCH OF 30 STUDENTS**

| | | |
|---|---|---|
| 1. | Muffle Furnace | 1 |
| 2. | Tempering Furnace | 1 |
| 3. | Metallurgical Microscopes & Invertoscope | 6 |
| 4. | Abrasive Cut-off Machine | 1 |
| 5. | Specimen Grinding Machine | 1 |
| 6. | Belt Polisher | 2 |
| 7. | Cloth Polisher | 2 |

DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN METALLURGY

II YEAR

M SCHEME

IV SEMESTER

2015 -2016 onwards



# 32647 – LATHE & SPECIAL MACHINES PRACTICAL

CURRICULUM DEVELOPMENT CENTRE

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**

**DIPLOMA IN METALLURGY**
**M-SCHEME**
**(To be implemented to the student admitted from the Year 2015-2016 on wards)**

| | | |
|---|---|---|
| Course Name | **:** | DIPLOMA IN METALLURGY |
| Course Code | : | 1026 |
| Subject Code | **:** | **3**2647 |
| Semester | **:** | IV Semester |
| Subject Title | **:** | **LATHE & SPECIAL MACHINES PRACTICAL** |

**TEACHING AND SCHEME OF EXAMINATION:**

No of weeks per semester: 15 weeks

| Subject Title | Instructions | | Examination | | | |
|---|---|---|---|---|---|---|
| | Hours /Week | Hours /Semester | Marks | | | Duration |
| | | | Internal Assessment | Board Examination | Total | |
| Lathe & Special Machines Practical | 4 Hrs | 15 X 4 = 60 Hrs | 25 | 75 | 100 | 3 Hrs |



**RATIONALE:**

Basic skills in various shaping equipments should be given to Diploma Engineers. Exposure to the working principles and various kinds of tools and methods of Turning, Drilling operations should be given.

**OBJECTIVES:**

- Identify the parts of a center lathe
- Identify the work holding devices
- Set the tools for various operations
- Operate the lathe and Machine a component using lathe
- Identify the tools used in foundry.
- Identify the tools and equipments used in welding
- Prepare sand moulds for different patterns.
- Perform welding operation to make different types of joints.
- Identify the different welding defects.
- Appreciate the safety practices used in welding.

**Note:** All dimensions in mm

Manufacture and estimate the cost of the job for following exercises by assuming the suitable raw material for the final size of the components.

**Lathe, Drilling & Shaping Machines**

**Syllabus:**

1. Introduction of safety in operating machines.
2. Introduction to lathe, drilling machine & shaping machine and its parts.
3. Introduction to work holding devices and tool holding devices.
4. Types of tools used in lathe work, drilling & shaping.
5. Types of measuring instruments and their uses.
6. Setting of work and tools.
7. Operation of lathe, drilling & shaping.
8. Practice on a lathe, drilling and shaping machine

**Note**: The dimensions may be modified according to the materials availability.

**Enclosure:** Sketches of Lathe, drilling & shaping Exercises.



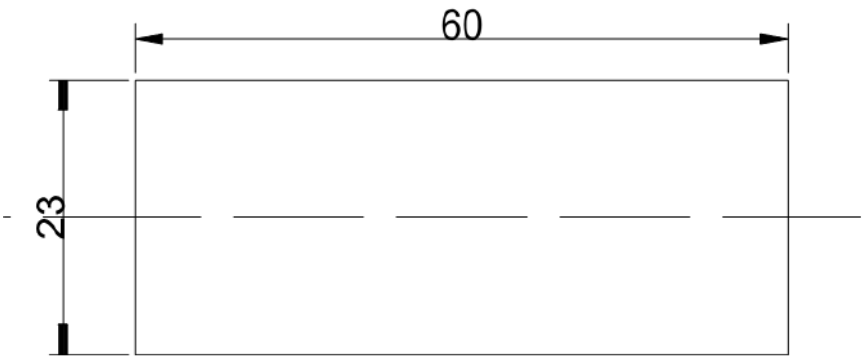
**BOARD EXAMINATION: Scheme of Examination**

| | |
|---|---|
| Lathe exercise | : 45 marks (2 hours) |
| Shaping / Drilling by lot | : 25 marks (1 hour) |
| Viva-Voce | : 05 marks |
| **Total** | **: 75 marks** |

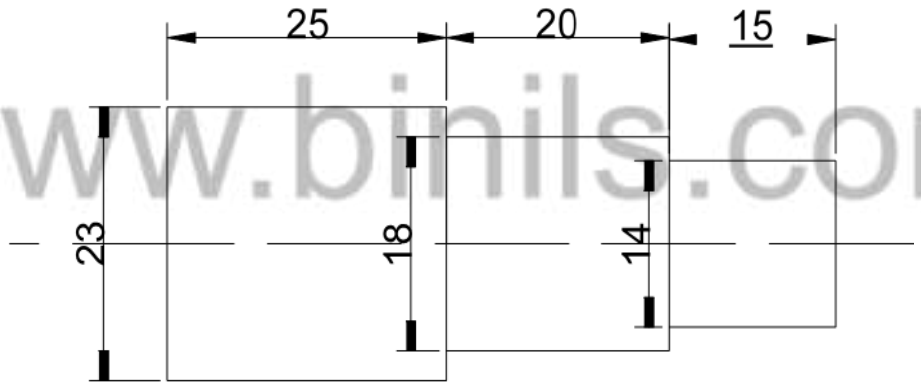
**TURNING**

**(M.S Material – Size 60×25mm)**

**1. Plain turning**

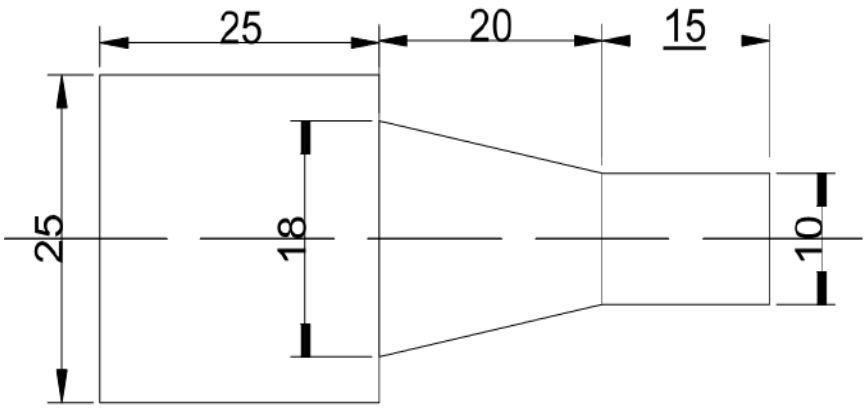



**2. Step turning**

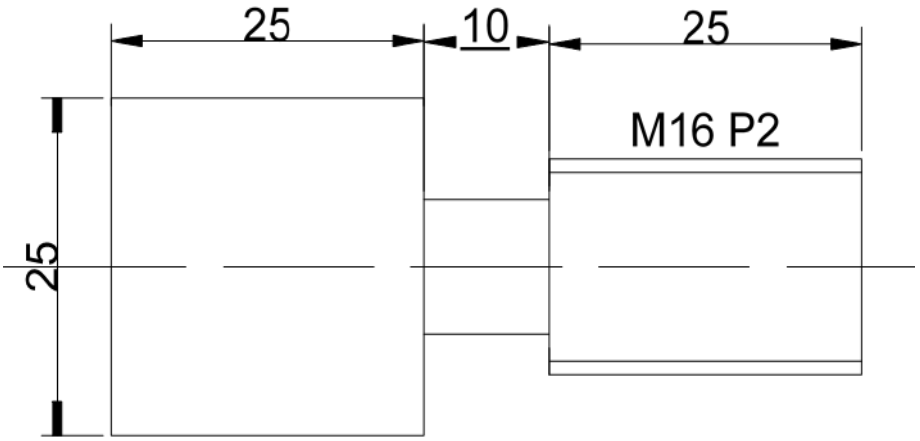




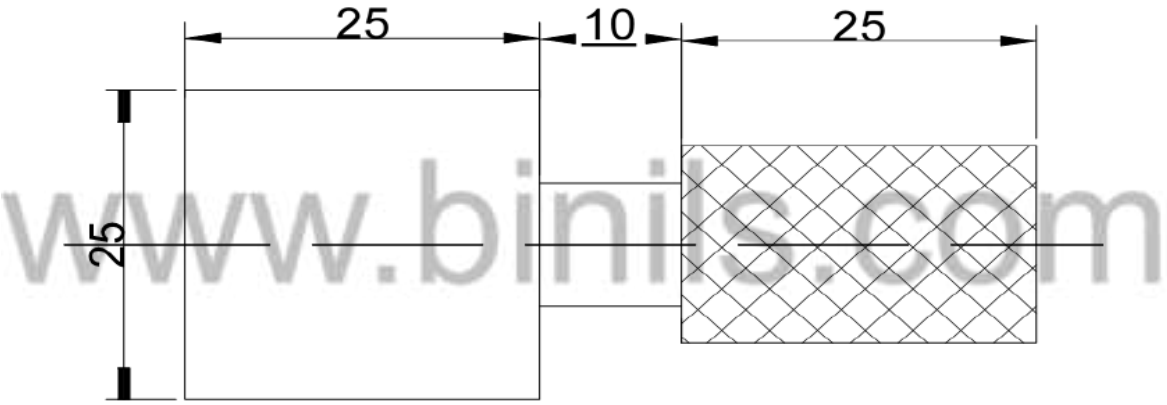

**3. Taper turning**



**4. Thread cutting**

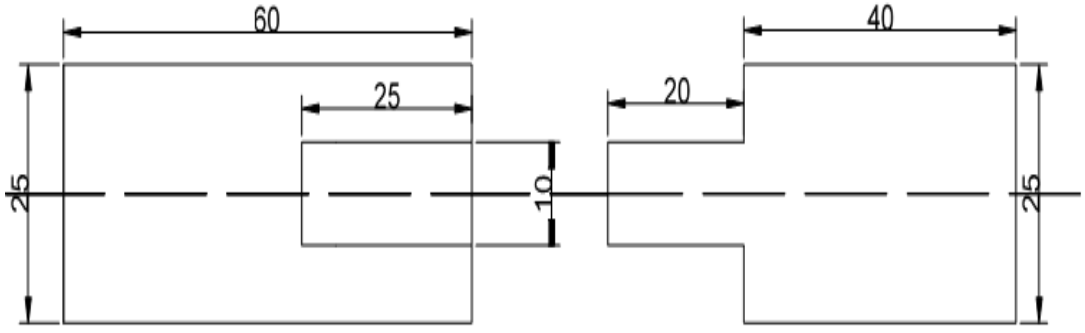



**5. Knurling**





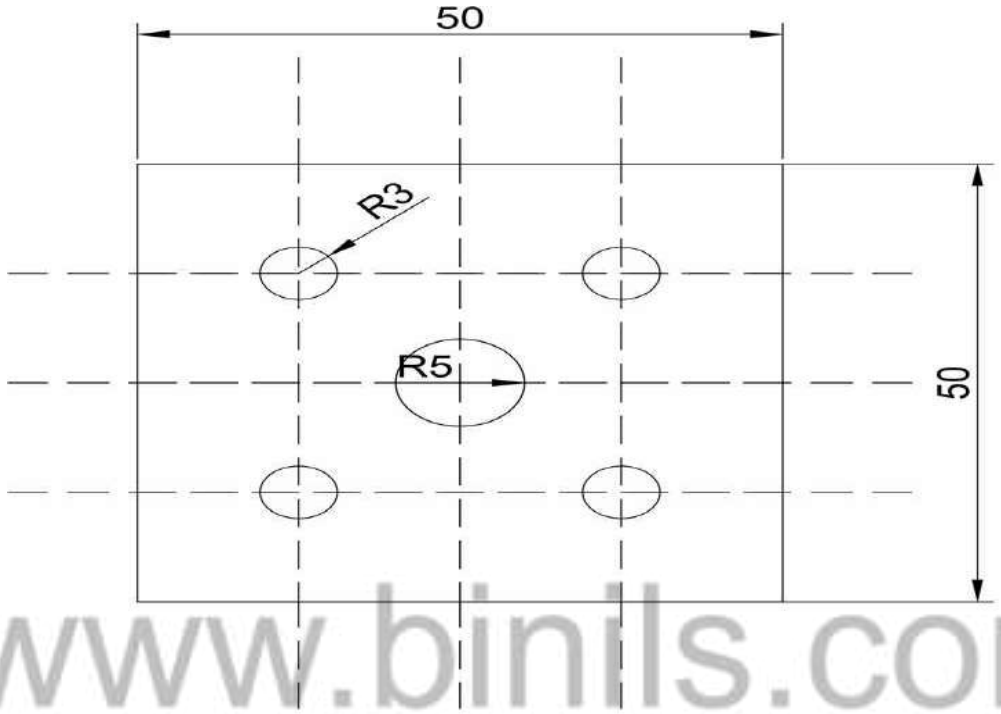

**6. Bushing**



**DRILLING**

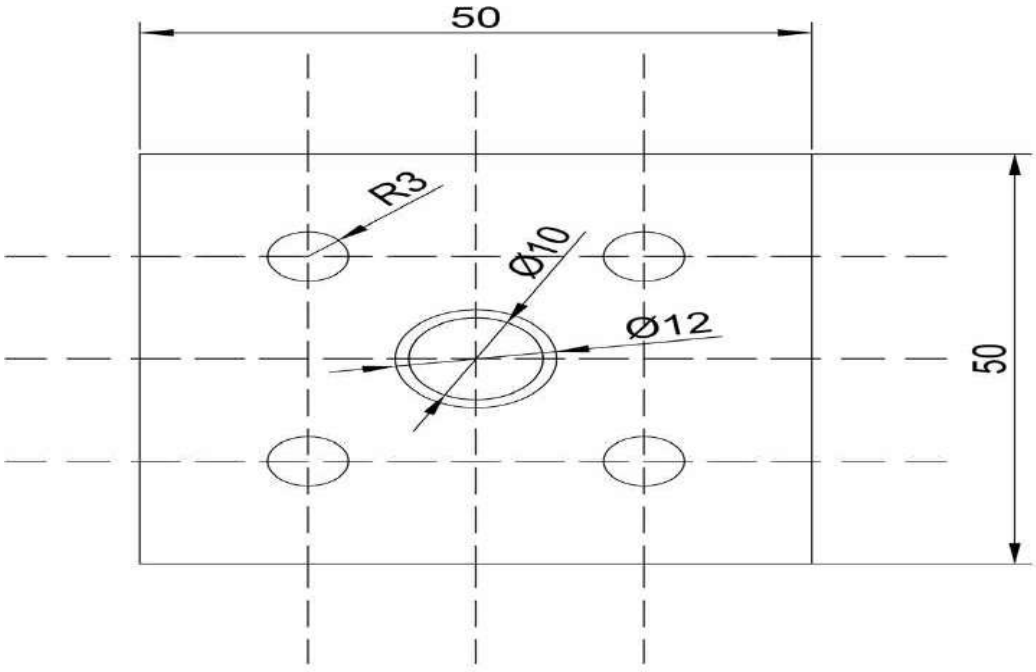
**(M.S Material – Size 50×50×6mm)**

**7. Through hole drilling**





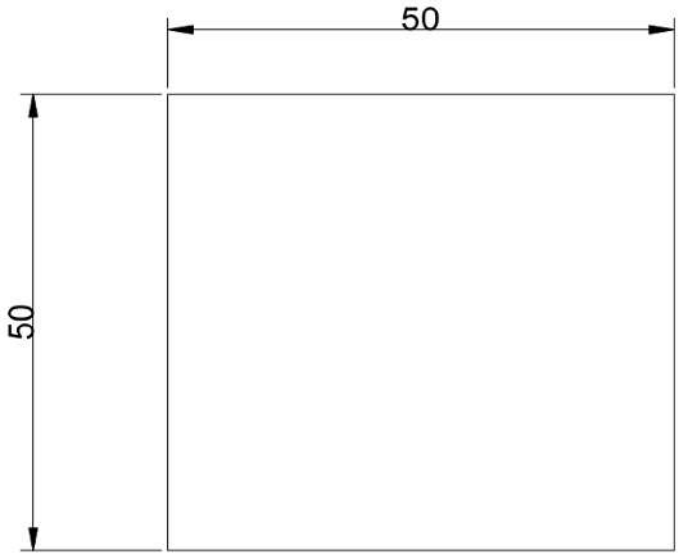

**8. Through hole drilling with counter sinking**



## SHAPING

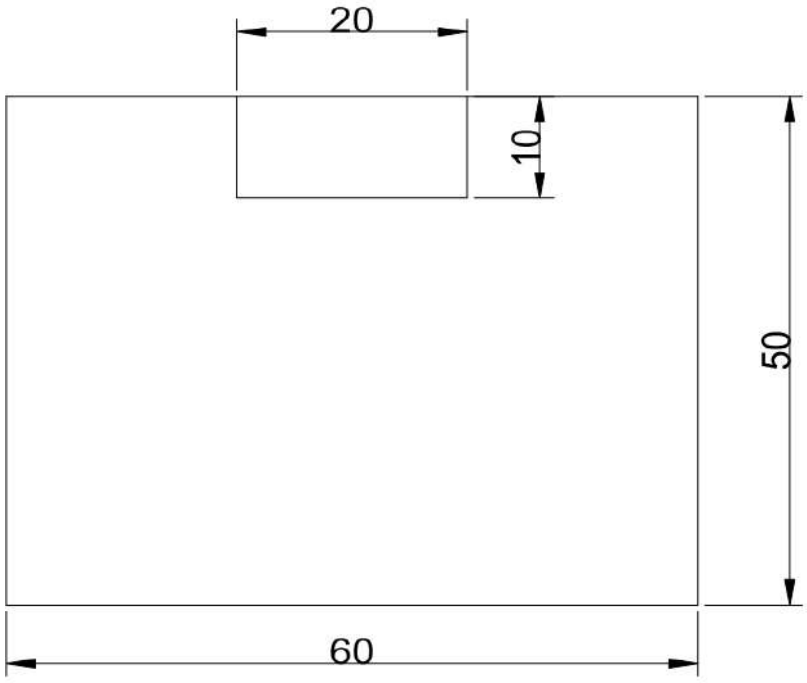
**(M.S Material – Size 60×60×60 mm)**

**9. Machining flat surface using a shaper**






**10. Slotting using a shaper**



## LIST OF EQUIPMENT

**Machines and Instruments:**

| Sl. No. | Description | Qty. |
|---|---|---|
| 1. | Drilling Machine | 1 |
| 2. | Shaping Machine | 1 |
| 3. | Centre Lathe 4 ½ ‘ Bed length | 15 |
| 4. | 4 Jaw / 3 Jaw Chucks | required Numbers |
| 5. | Chuck key (10 mm x 10 mm size) | 15 |
| 6. | Box spanner | 15 |
| 7. | Cutting Tool H.S.S ¼ ‘’ X ¼ ‘’ X 4 ‘’ long | 15 |
| 8. | Pitch gauge | 5 |
| 9. | Vernier Caliper (0-25 and 25-50) | 5 |
| 10. | Micrometer, Inside and Outside(0-25 and 25-50) | 5 each |
| 11. | Vernier Height Gauge(300mm) | 1 |
| 12. | Snap gauge | 1 set |
| 13. | Gear tooth Vernier | 1 |
| 14. | Parallel Block | 2 |
| 15. | Steel Rule (0-150) | 15 |
| 16. | Outside and Inside Calipers | 15 each |
| 17. | Thread gauge | 5 |
| 18. | Bevel Protractor | 1 |
| 19. | Jenny Caliper | 5 |
| 20. | Dial Gauge with Magnetic Stand | 5 |
| 21. | Marking Gauge | 10 |
| 22. | Safety Glass | 15 |

# V SEMESTER

DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN METALLURGY

III YEAR

M SCHEME

V SEMESTER

2015 -2016 onwards



# 32651 – MECHANICAL METALLURGY

CURRICULUM DEVELOPMENT CENTRE

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**

**DIPLOMA IN METALLURGY**
**M-SCHEME**
**(To be implemented to the student admitted from the Year 2015-2016 on wards)**

Course Name : DIPLOMA IN METALLURGY
Course Code : 1026
Subject Code : **3**2651
Semester : V Semester
Subject Title : **MECHANICAL METALLURGY**

**TEACHING AND SCHEME OF EXAMINATION:**

No of weeks per semester: 15 weeks

| Subject Title | Instructions | | Examination | | | |
|---|---|---|---|---|---|---|
| | Hours /Week | Hours /Semester | Marks | | | Duration |
| | | | Internal Assessment | Board Examination | Total | |
| Mechanical Metallurgy | 5 Hrs | 15 X 5 = 75 Hrs. | 25 | 75 | 100 | 3 Hrs |



**Topics and Allocation of Hours:**

| Unit No | Topics | Time(Hrs) |
|---|---|---|
| I | Behaviour of Metals, Tension Test and Hardness Test | 14 |
| II | Torsion, Impact, Fatigue and Creep Test | 14 |
| III | Fundamentals of metal Working Processes and Forging | 14 |
| IV | Rolling and Extrusion Processes | 13 |
| V | Drawing and Sheet metal Forming Operations. | 13 |
| | Revision and Test | 7 |
| TOTAL | | 75 |

**RATIONALE:**

Generally various components are produced by casting processes. But to produce various components from metals which are not having good cast ability (like steel)other metal working processes are used to produce various components .For this the syllabus is designed to know the basics of metal working processes in first and second units. The fundamentals of metal working processes are discussed in the 3rd unit .The main basic processes like forging, rolling and extrusion are discussed in the 4th unit. Other metal working processes of drawing and sheet metal forming operations are discussed in the 5th unit.

**OBJECTIVES:**

At the end of the study of V Semester the student will be able to

- To know about the Basic behaviours of metals related to metal Forming Processes
- To know about the various parameters in Tension Test
- To know about the different Hardness testing methods
- To know about the Torsional behaviours of metals
- To know about the Impact, Fatigue and Creep tests
- To know about the Fundamentals of metal Working Processes
- To know about the different Processes, Equipments and Defects in Forging.
- To know about the different Processes, Equipments and Defects in Rolling.
- To know about the different Processes, Equipments and Defects in Extrusion.
- To know about the different drawing Operations.
- To know about the Sheet Metal Forming Operations.

## 32651. MECHANICAL METALLURGY

DETAILED SYLLABUS

Contents: Theory

| Unit | Name of the Topic | Hours |
|---|---|---|
| I | **BEHAVIOR OF METALS, TENSION TEST AND HARDNESS TEST**<br>Introduction to strength of materials- Basic assumptions<br>Elastic and plastic Behaviour.<br>Deformation on load of ductile metals<br>Ductile Vs. Brittle Behaviour.<br>**Tension Test:**<br>Tensile testing<br>Anelastic behaviour<br>Engineering stress-strain curve<br>True stress-strain curve<br>Effect of strain rate on tensile properties<br>Effect of temperature on tensile properties<br>Combined effect of strain rate and temp on tensile properties<br>**Compression Testing:**<br>Principle of hardness testing<br>Brinell hardness test<br>Vickers hardness test<br>Rockwell hardness test<br>Micro- hardness test.<br>Hardness at elevated temperatures | **14** |
| II | **TORSION, IMPACT, FATIGUE AND CREEP TEST**<br>**Principles of torsion testing:**<br>Mechanical Properties in torsion testing<br>Torsion test Vs. Tension test<br>**Impact Test:**<br>Notched bar impact test: Charpy & Izod methods<br>**Fatigue test:**<br>Stress cycles, S-N curve, Low cycle fatigue, Structural features of fatigue and Thermal fatigue<br>**Creep test**<br>High temperature materials problems<br>Time dependant mechanical behaviour<br>Creep curve<br>Stress rupture test | **14** |

| | | |
|---|---|---|
| III | **FUNDAMENTALS OF METAL WORKING PROCESSES AND FORGING** **Fundamentals of metal working:**<br>Classification of forming processes<br>Effect of temperature:<br>Hot working and cold working<br>Effect of Strain - rate on forming processes<br>Effect of metallurgical structure on forming processes<br>Workability or Formability Criteria<br>Residual stresses<br>**Forging:**<br>Classification of forging process<br>Forging equipments<br>Forging defects. | **14** |
| IV | **ROLLING AND EXTRUSION PROCESSES**<br>**ROLLING:**<br>Classification of rolling process<br>Rolling mills<br>Hot rolling<br>Cold rolling<br>Rolling of bars and shapes<br>Variables in rolling<br>Defects in rolled products<br>**EXTRUSION:**<br>Types of extrusion processes<br>Extrusion equipment<br>Variables in extrusion<br>Defects in extruded products<br>Extrusion of tubing<br>Production of seamless pipe and tubing | **13** |
| V | **DRAWING AND SHEET METAL FORMING OPERATIONS**<br>Rod drawing<br>Wire drawing<br>Tube drawing<br>Defects in rod and wire drawing<br>Sheet metal forming:<br>Forming Methods<br>Shearing and blanking processes<br>Bending processes<br>Stretch forming process<br>Deep drawing operations<br>Redrawing operations<br>Defects in the formed parts | **13** |

**TEXT BOOK:**

1. Mechanical Metallurgy, Dieter G E ,Mc Graw Hill Co, SI Edition, 1995.
2. Metal Forming - Processes and Analysis, Avitzur, Tata Mc Graw Hill Co, 1977.

**Reference Books:**

1. Elements of Metallurgy, Dr.Swarup & Dr.Saxena Rastogi Publication, Meerut.
2. ASM “Metals Handbook, Vol.14. Forming & Forging”
ASM, Metals Park, Ohio, USA.
3. The making, shaping and treating of steel, U.S. Steel Ninth Edition,
U.S Steel corporation.

DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN METALLURGY

III YEAR

M SCHEME

V SEMESTER

2015 -2016 onwards



# 32652 - MANUFACTURING PROCESS USING CNC MACHINES

CURRICULUM DEVELOPMENT CENTRE

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**

**DIPLOMA IN METALLURGY**
**M-SCHEME**
**(To be implemented to the student admitted from the Year 2015-2016 on wards)**

| | | |
|---|---|---|
| Course Name | : | DIPLOMA IN METALLURGY |
| Course Code | : | 1026 |
| Subject Code | : | 32652 |
| Semester | : | V Semester |
| Subject Title | : | **MANUFACTURING PROCESS USING CNC MACHINES** |

## TEACHING AND SCHEME OF EXAMINATION:

No of weeks per semester: 15 weeks

| Subject Title | Instructions | | Examination | | | |
|---|---|---|---|---|---|---|
| | Hours /Week | Hours /Semester | Marks | | | Duration |
| | | | Internal Assessment | Board Examination | Total | |
| Manufacturing Process using CNC Machines | 5 Hrs | 15 X 5 = 75 Hrs | 25 | 75 | 100 | 3 Hrs |



**Topics and Allocation of Hours:**

| Sl. No. | Topic | Time (Hrs) |
|---|---|---|
| I | INTRODUCTION CIM AND COMPUTER AIDED DESIGN & ANALYSIS | 14 |
| II | COMPUTER AIDED MANUFACTURING AND RAPID PROTOTYPING | 14 |
| III | CNC MACHINE AND COMPONENTS | 14 |
| IV | PART PROGRAMMING | 13 |
| V | FMS, INTEGRATED MATERIAL HANDLING AND ROBOT | 13 |
| | REVISION AND TEST | 7 |
| TOTAL | | 75 |

**RATIONALE:**

As per the latest requirements in the Industries this enables to learn the assistance of computer in the field of design and manufacturing areas. It's able to learn the latest manufacturing concepts of in the shop floors and manufacturing methods like RPT. They are able to know about the working of principles of CNC machines and programming techniques are included. The application of material handling equipments and robots are learnt based on the automation in the industries.

**OBJECTIVES:**

- Understand the concept and requirement of the integration of the design and manufacturing.
- Acquire knowledge about the computer assistance in the design process and analysis.
- Understand the concepts of manufacturing with computer assistance in the shop floor.
- Learn the principle and working of the CNC machines.
- Understand the principle of latest manufacturing machines like EDM and RPT.
- Learn the method of CNC programming with international codes.
- Acquire the knowledge in the material handling equipment and robot.

## 32652 - MANUFACTURING PROCESS USING CNC MACHINES

**DETAILED SYLLABUS**

**Contents: Theory**

| Unit | Name of the Topic | Hrs |
|---|---|---|
| I | **INTRODUCTION CIM AND COMPUTER AIDED DESIGN & ANALYSIS**<br><br>**CIM:** Introduction of CIM – concept of CIM - evolution of CIM – CIM wheel – Benefits – integrated CAD/CAM.<br><br>**CAD:** Computer Aided Design **–** Introduction – CAD definition – Shigley's design process – CAD activities – benefits of CAD. Types of CAD system –Host and terminal based CAD system - PC based CAD system – workstation based CAD system – Networks, Networks Types, Topology and types - Graphics workstation – 2D&3D transformations – translation, scaling, rotation and Concatenation<br><br>**Geometric modeling**: Techniques: Wire frame modeling – surface modeling – solid modeling: Boundary representation – Constructive Solid Geometry – Comparison.<br>Graphics standard – Definition –Need - GKS– DXF.<br>Cost involved in design changes – Concept of Design for Excellence (DFX) – Guide lines of Design for Manufacture and assembly (DFMA).<br><br>**Finite Element Analysis:** Introduction – Development - Basic steps – Advantage | **14** |
| II | **COMPUTER AIDED MANUFACTURING AND RAPID PROTOTYPING**<br><br>**CAM:** Definition – functions of CAM – benefits of CAM – Group technology – Part families - Parts classification and coding - coding structure – Optiz system, MICLASS system and CODE System – Production flow analysis (PFA) – process planning – CAPP – Types of<br><br>**CAPP :** Variant type, Generative type – advantages of CAPP – production planning and control – computer integrated production management system – Master Production Schedule (MPS) – Capacity planning – Materials Requirement Planning (MRP) –Manufacturing Resources Planning (MRP-II) – Shop floor control system<br>Product Development Cycle – Sequential engineering – Concurrent engineering.<br><br>**Rapid proto typing**: concept and applications – materials – types – Stereo lithography – laser sintering – Deposition Modeling - 3D printing. | **14** |

| | | |
|---|---|---|
| **III** | **CNC MACHINE AND COMPONENTS**<br>**CNC Machines:** Numerical control – definition – components of NC systems – development of NC – DNC – Adaptive control systems – working principle of a CNC system – Features of CNC machines - advantage of CNC machines – difference between NC and CNC – Construction and working principle of turning centre – Construction and working principle of machining centers – machine axes conventions turning centre and machining centre – design considerations of NC machine tools. CNC EDM machine – Working principle of die sinking and wire EDM machines - Coordinate Measuring Machines: construction and working principles.<br><br>**Components of CNC machine.**<br>**Drives:** spindle drive – dc motor – Feed drives – dc servo motor and stepper motor – hydraulic systems – Slide ways – requirement – types – friction slide ways and anti friction slide ways - linear motion bearings – recirculation ball screw – ATC – tool magazine – feedback devices – linear and rotary transducers – Encoders - in process probing. | **14** |
| **IV** | **PART PROGRAMMING**<br>NC part programming – methods – manual programming – conversational programming – APT programming - Format: sequential and word address formats - sequence number – coordinate system – types of motion control: point-to-point, paraxial and contouring – Datum points: machine zero, work zero, tool zero NC dimensioning – reference points – tool material – tool inserts - tool offsets and compensation - NC dimensioning – preparatory functions and G codes, miscellaneous functions and M codes – interpolation: linear interpolation and circular interpolation - CNC program procedure. Part Program – macro – sub-program – canned cycles: stock – mirror images – thread cutting – Sample programs for lathe : Linear and circular interpolation - Stock removal turning – Peck drilling – Thread cutting and Sample programs for milling: Linear and circular interpolation – mirroring – sub program – drilling cycle – pocketing – Generating CNC codes from CAD models – post processing. | **13** |
| **V** | **FMS, INTEGRATED MATERIAL HANDLING AND ROBOT**<br>Types of manufacturing - introduction to FMS – FMS components – FMS layouts – Types of FMS: flexible manufacturing cell – flexible turning cell – flexible transfer line – flexible machining systems – benefits of FMS - introduction to intelligent manufacturing system – virtual machining.<br><br>Computer Integrated material handling – AGV: working principle – types - benefits – Automatic Storage and Retrieval Systems (ASRS).<br><br>ROBOT – definition – robot configurations – basic robot motion – robot programming method – robotic sensors - industrial applications: characteristics, material transfer, machine loading, welding, spray coating, assembly and inspection. | **13** |

**Text Books :**

1) CAD/CAM/CIM , R.Radhakrishnan, S.Subramanian,
New Age International Pvt. Ltd.
2) CAD/CAM , Mikell P.Groover, Emory Zimmers, Jr.Prentice Hall of India Pvt., Ltd.
3) NC Programming, S.K.Sinha, Galgotia Publications Pvt. Ltd.

**Reference Books :**

1) CAD/CAM Principles and Applications, Dr.P.N.Rao,
Tata Mc Graw Hill Publishing Company Ltd.
2) CAD/CAM, Ibrahim Zeid, Mastering
Tata McGraw-Hill Publishing Company Ltd.,New Delhi.
3) Automation, Production Systems, and Computer-Integrated Manufacturing,
Mikell P. Groover, Pearson Education Asia.
4) Computer control of manufacturing systems,Yoram Koren, McGraw Hill Book.

DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN METALLURGY

III YEAR

M SCHEME



V SEMESTER

2015 -2016 onwards

**32653 – METAL CASTING**

CURRICULUM DEVELOPMENT CENTRE

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**

**DIPLOMA IN METALLURGY**
**M-SCHEME**
**(To be implemented to the student admitted from the Year 2015-2016 on wards)**

Course Name : DIPLOMA IN METALLURGY
Course Code : 1026
Subject Code : **3**2653
Semester : V Semester
Subject Title : **METAL CASTING**

**TEACHING AND SCHEME OF EXAMINATION:**

No of weeks per semester: 15 weeks

| Subject Title | Instructions | | Examination | | | |
|---|---|---|---|---|---|---|
| | Hours /Week | Hours /Semester | Marks | | | Duration |
| | | | Internal Assessment | Board Examination | Total | |
| Metal Casting | 5 Hrs | 15 X 5 = 75 Hrs | 25 | 75 | 100 | 3 Hrs |



**Topics and Allocation of Hours:**

| Unit No | Topic | Time (Hrs) |
|---|---|---|
| I | Introduction, Pattern and Cores | 14 |
| II | Mould materials, processes and methods | 14 |
| III | Gating and risering system | 14 |
| IV | Special casting techniques and fettling | 13 |
| V | Defects and salvaging | 13 |
| | Revision and Test | 7 |
| TOTAL | | 75 |

**RATIONALE:**

Engineering and Non -engineering applications requires components made up of materials with required properties. There are various manufacturing processes available to produce components. Casting is the most important manufacturing process producing most of the Industrial and Automobile components. It is a very basic subject and should be studied.

It is a process which produces components in a large scale at economic price with Uni- Directional Properties. This subject deals with various basic requirements for Casting Process. It also deals various Moulding processes and some Important Special Casting Methods. The Common defects that may occur during casting process and their remedies are also included.

**OBJECTIVES:**

At the end of the study of V Semester the student will be able to

- Learn advantages & limitations of casting process over other manufacturing processes.
- Learn about basic tools for making mould cavity.
- Learn about mould making materials, ingredients and their properties.
- Learn about moulds and moulding processes and methods.
- Learn about mould properties and mould coatings.
- Learn about objectives, types and basic principles of designing gating systems.
- Learn about objectives, types and basic principles of designing risering systems.
- Learn about methods used for making intricate castings.
- Learn about finishing operations of castings.
- Learn about causes and remedies for defects.
- Learn about methods for salvaging defective castings.

## 32653 - METAL CASTING

DETAILED SYLLABUS

Contents: Theory

| Unit | Name of the Topic | Hrs |
|---|---|---|
| I | **INTRODUCTION, PATTERN AND CORES**<br><br>Introduction - Metal casting - a shaping process - steps involved in making a casting – Advantages of Metal casting - applications of metal casting.<br>Foundry: Definition - types of foundry - Raw materials for foundry.<br>Pattern: Introduction - Difference between pattern and casting – functions of patterns –Selection of pattern materials - pattern making materials, advantages & disadvantages<br>Types of patterns – one piece pattern - split pattern – loose piece pattern – Match plate pattern - cope and drag pattern - gated pattern - sweep pattern - segmental pattern - follow board pattern - skeleton pattern<br>Pattern design considerations<br>Pattern allowances - shrinkage allowances – machining allowances – taper or draft allowances – distortion allowances –shake allowances –<br>Pattern making tools – pattern layout - pattern construction - pattern colour codes - storing of patterns.<br><br>Core - Definition - functions - characteristics.<br>- Core applications Types: Horizontal core - vertical core, hanging core, balanced core, drop core, Ram-up core.<br>- core boxes - core prints<br>- Hot box process, Cold set process. | 14 |
| II | **MOLD MATERIALS, PROCESSES AND METHODS**<br><br>Mould Materials: Moulding sand - source - types - Natural sand, synthetic sand - Loam sand.<br>Ingredients: Sand grains - Grain size, grain shape.<br>Sand binders - fire clay, Bentonite, Illite, Limonite, Kaolinite – Bond formation theories<br>Moistures: Free water, combined waters<br>Additives: Facing materials, cushioning materials<br>Properties of moulding sand Types of sand used in moulds (12 types)<br>Moulds: Definition Characteristics of mould. | 14 |

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|---|---|---|
| | Moulding Process: Green sand moulding - dry sand moulding - skin dried moulding – Loam sand moulding - shell moulding – cement bonded sand moulding – Carbon dioxide moulding - ceramic moulding - Graphite moulding.<br>Moulding methods: Bench moulding - floor moulding – pit moulding – Machine moulding squeeze machine - Jolt machine - Jolt squeeze machine. Mould surface coatings. | |
| **III** | **GATING AND RISERING SYSTEM**<br><br>Gating System: Objective of gating system - system components – types of gating systems - top gates (all types) - bottom gates (all types) parting line gates (all types) - multiple gating systems.<br>Gating Design: Basic principles in gating system - Metal fluidity – Fluid flow principles – Reynolds number - law of continuity - Bernoulli's theorem – Pouring rate – choke area - gating ratio - simple calculations.<br>Risering system: Objectives - design parameters - casting yield – types of risers<br>Riser locations - shape of risers Chills - padding - insulating and exothermic materials. | **14** |
| **IV** | **SPECIAL CASTING TECHNIQUES AND FETTLING**<br><br>Special casting methods: Gravity die casting - pressure die casting –hot chamber die casting - cold chamber die casting –centrifugal die casting - investment mould casting.<br>Fettling: Removal of cores - cleaning of casting surfaces - Hand methods – mechanical methods – Tumbling air blasting mechanical blast cleaning Hydroblasting - Chemical cleaning.<br>Removal of gates and risers – chipping, flogging, shearing, sawing, abrasive wheel slitting Machining, flame cutting, plasma cutting.<br>Removal of Fins and other projections.<br>Surface treatments of castings. Melting of Copper – Melting Aluminium | **13** |
| **V** | **DEFECTS AND SALVAGING**<br>Casting Defects: Introduction - Classification of defects – Defects caused by pattern and moulding box equipments – Defects due to improper moulding and core making materials – Defects due to improper mould drying and core baking –Defects | **13** |

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|---|---|---|
| | occurring while closing and pouring – Defects due to molten metals – Defects occurring during fettling –Defects due to faulty Heat treatment Defects due to cast metal.<br>Inspection and Salvage Introduction - factors affecting salvage – Burning on method - Patches and plugs – Caulking and impregnation – Safety measurements and environmental safety. | |

**Text books**

1. Introduction to Foundry Technology, O.P.Khanna, Dhanpat Rai Publications, New Delhi.
2. Foundry engineering, N.K.Srinivasan, Khanna Tech Publications, New Delhi.

**Reference Books:**

1. Principle of metal casting, Heine, Loper and Rosenthal, Tata McGraw Hill, New Delhi.
2. Foundry Technology, Beeley Butterworth, London.
3. ASM metals handbook Vol.15.
4. Metal Casting Principles & Practice, T.V.Ramana Rao, New Age International Pub Company, New Delhi.

DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN METALLURGY

III YEAR

M SCHEME

V SEMESTER



2015 -2016 onwards

**32671 – NON DESTRUCTIVE TESTING**

CURRICULUM DEVELOPMENT CENTRE

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**

**DIPLOMA IN METALLURGY**
**M-SCHEME**
**(To be implemented to the student admitted from the Year 2015-2016 on wards)**

Course Name : DIPLOMA IN METALLURGY
Course Code : 1026
Subject Code : **3**2671
Semester : V Semester
Subject Title : **NON DESTRUCTIVE TESTING**

**TEACHING AND SCHEME OF EXAMINATION:**

No of weeks per semester: 15 weeks

| Subject Title | Instructions | | Examination | | | |
|---|---|---|---|---|---|---|
| | Hours /Week | Hours /Semester | Marks | | | Duration |
| | | | Internal Assessment | Board Examination | Total | |
| Non Destructive Testing | 5 Hrs | 15 X 5 = 75 Hrs | 25 | 75 | 100 | 3 Hrs |



**Topics and Allocation of Hours:**

| Unit No | Topic | Time(Hrs) |
|---|---|---|
| I | Aspects of NDT, various defects, visual inspection & leak testing | 14 |
| II | Liquid penetrant testing & Magnetic particle inspection | 14 |
| III | Radiography | 14 |
| IV | Ultrasonic testing | 13 |
| V | Eddy current testing, Acoustic emission & Thermography | 13 |
| | Revision and Test | 7 |
| TOTAL | | 75 |

**RATIONALE:**

Modern testing methods should be fast, accurate and highly reliable and which helps in predicting the soundness of parts made by various manufacturing processes. By doing this practical the students will be given the opportunities and confidence of handling various new and sophisticated instruments for ensuring the quality of the product/part manufactured.

**OBJECTIVES:**

At the end of the study of V Semester the student will be able to

- The subject provides advanced methods of testing the components without impairing the engineering utility of the components.
- Various methods and aids used for Visual inspection & Leak testing are discussed.
- Acquire knowledge about the principles and types of Liquid Penetrant tests to find surface defects.
- To impart knowledge about Magnetic Particle Inspection to locate surface and sub-surface defects.
- Testing the components using X-ray & Gamma rays will help the faster and accurate methods of NDT.
- Radiation safety and Monitoring will provide safe handling and maintenance with Radiography.
- The topic provides detection of minute flaws and measurement using Ultrasonic waves.
- Various techniques of scans& types are discussed to test the components using Ultrasonic waves.
- Advanced techniques like Eddy Current, Acoustic Emission & Thermography will be helpful in identifying defects like compositional mix-ups etc.

## 32671. NON DESTRUCTIVE TESTING

DETAILED SYLLABUS

Contents: Theory

| Unit | Name of the Topic | Hours |
|---|---|---|
| I | **ASPECTS OF NDT, VARIOUS DEFECTS, VISUAL INSPECTION & LEAK TESTING**<br>Introduction – Basic concepts of Non Destructive Testing – Steps involved in any NDT – Relative Merits and Limitations of NDT versus conventional testing.<br>Types, Comparisons and Selection of NDT method:<br>Defects in materials: Casting defects, Forging defects, Rolling defects, Extrusion defects, Drawing defects & Welding defects.<br>Defects introduced during service: Cause of Material failure & Types of Material failure.<br>Selection of NDT method: Factors involved.<br>**VISUAL INSPECTION:**<br>Principles – Defects detected by Visual Inspection – Optical aids used for Visual Inspection like Microscope, Boroscope, Endoscope, Flexiscope, Telescope & Holography.<br>Applications.<br>**LEAK TESTING:**<br>Introduction – Measurement of leak – Leak testing methods – Leak detection: Bubble testing & Helium leak detector. | 14 |
| II | **LIQUID PENETRANT TESTING & MAGNETIC PARTICLE INSPECTION LIQUID PENETRANT TESTING:**<br>Introduction – Physical principles – Procedure for Penetrant testing – Penetrant testing materials – Methods – Sensitivity – Applications and Limitations.<br>**MAGNETIC PARTICLE INSPECTION:**<br>Introduction – Basic definitions and principles of MPT – Magnetizing techniques – Procedure for testing a component – Equipment used for MPT – Sensitivity – Limitations. | 14 |

| | | |
|---|---|---|
| **III** | **RADIOGRAPHY**<br>Introduction – Basic principles – Production of X-rays & Gamma ray source.<br>Properties of X-ray & Gamma rays. – Radiation attenuation in the specimen – Effect of radiation on Film – Radiographic Imaging:- Geometrical factor, Radiographic film, Intensifying screens, Film density, Radiographic sensitivity, Penetrameters, Determining radiographic exposure.<br>Inspection Techniques: Single wall single Image technique, Double wall penetration technique, Latitude technique, Special techniques. Applications & limitations.<br>Real time Radiography.<br>Safety involved in Industrial radiography: Radiation units, Limits for radiation exposure, Methods for exposure control & Radiation monitoring. | **14** |
| **IV** | **ULTRASONIC TESTING**<br>Introduction – Basic concepts of sound beam – Velocity of Ultrasonic waves – Acoustic Impedance – Behaviour of Ultrasonic waves – Ultrasonic Transducers – Characteristics of Ultrasonic beam – Attenuation.<br>Inspection technique: Pulse – Echo, Through-Transmission & Angle Beam pulse-echo.<br>Criteria for probe selection – Flaw sensitivity, Beam divergence, Penetration & Resolution.<br>Techniques for Normal beam inspection: Fatigue crack, Inclusion, Slag, Porosity & Large grain structure, Thickness measurement & Intergranular crack/ Hydrogen attack.<br>Techniques for Angle beam inspection.<br>Pipe inspection.<br>Ultrasonic Flaw detection equipment.<br>Modes of Display: A scan, B scan & C scan.<br>Immersion testing.<br>Applications, Advantages & Limitations. | **13** |
| **V** | **EDDY CURRENT TESTING, ACOUSTIC EMISSION & THERMOGRAPHY, EDDY CURRENT TESTING**<br>Introduction – Principles – Various factors affecting Eddy current like Test frequency, Depth of penetration & frequency, Lift off, Conductivity, Magnetic permeability & Geometry – Instrumentation for ECT .<br>Techniques: High sensitivity techniques.<br>Inspection of Heat exchanger tube by Single frequency ECT & Multi frequency ECT.<br>Inspection of Ferro Magnetic materials. Sensitivity.<br>SQUID based Eddy current Testing. | **13** |

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|---|---|---|
| | Applications & Limitations.<br>**ACOUSTIC EMISSION TESTING:**<br>Principles, Technique, Instrumentation, Sensitivity & Applications.<br>**THERMOGRAPHY:**<br>Basic principles, Detectors, Equipments, Techniques & Applications. | |

**Text Books:**

1. Practical Non Destructive Testing
   Baldevraj, Jayakumar.T, Thavasimuthu M., Narosa Pub.Home, New Delhi.
2. Non-Destructive Test and Evaluation of Materials, II Edition,
   J. Prasad and C.G.K. Nair, Tata McGraw Hill Education Pvt. Ltd., New Delhi.

**Reference Books:**

1. Non Destructive Testing – WT Mc Gonnagle, McGraw Hill.
2. Metals Hand book Vol. II: NDT & Inspection.
3. Testing & Inspection of Engineering Materials,
   Davis Troxell & Wiskocil, MC Graw Hill.
4. Non Destructive Testing, Barry Hull & Vemon John, ELBS / Macmillan
5. Non Destructive Testing – Louis Cartz,
   ASM International Metals Park, Ohio, USA.

DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN METALLURGY

III YEAR

M SCHEME



V SEMESTER

2015 -2016 onwards

**32672 – CORROSION AND SURFACE ENGINEERING**

CURRICULUM DEVELOPMENT CENTRE

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**

**DIPLOMA IN METALLURGY**
**M-SCHEME**
**(To be implemented to the student admitted from the Year 2015-2016 on wards)**

Course Name : DIPLOMA IN METALLURGY
Course Code : 1026
Subject Code : 32672
Semester : V Semester
Subject Title : **CORROSION AND SURFACE ENGINEERING**

**TEACHING AND SCHEME OF EXAMINATION:**

No of weeks per semester: 15 weeks

| Subject Title | Instructions | | Examination | | | |
|---|---|---|---|---|---|---|
| | Hours /Week | Hours /Semester | Marks | | | Duration |
| | | | Internal Assessment | Board Examination | Total | |
| Corrosion And Surface Engineering | 5 Hrs | 15 X 5 = 75 Hrs | 25 | 75 | 100 | 3 Hrs |



**Topics and Allocation of Hours:**

| Unit No | | Time(Hrs) |
|---|---|---|
| I | MECHANISMS AND TYPES OF CORROSION | 14 |
| II | TESTING AND PREVENTION OF CORROSION | 14 |
| III | CORROSION BEHAVIOR OF MATERIALS | 14 |
| IV | SURFACE ENGINEERING FOR WEAR AND CORROSION RESISTANCE | 13 |
| V | THIN LAYER ENGINEERING PROCESSES | 13 |
| | REVISION AND TEST | 7 |
| Total | | 75 |

**RATIONALE:**

The subject provides the basic fundamental of corrosion and its prevention methodologies. All engineering fields are dealing with components made of different materials of widely varied nature in order to meet ever growing needs of modern world's needs. To select the materials, process them to suit our expectations, design and manufacture of components to perform adequately in the application.

All above concepts are provided to the students starting from materials combinations and their behaviour from view point of corrosion and surface engineering techniques. Various possible testing and prevention of corrosion are helpful in providing the ways to minimize the ill effects of corrosion and to control them. Also it provides the various materials and coating techniques available to resist corrosion.

**OBJECTIVES:**

At the end of the study of III Semester the student will be able to

- The corrosion methods and surface engineering will be understood.
- Acquire knowledge about the mechanisms of corrosion and testing methods.
- Able to analyze the corrosion behaviour of materials.
- Understand the surface engineering for wear and corrosion resistance of materials.
- Get knowledge about the hot dip coating and metal spraying etc.
- Imparts information about the diamond coating of tool and properties and application of thin coatings are studied.
- Various mechanisms of surface coatings of the materials could be understood.

## 32572 - CORROSION AND SURFACE ENGINEERING

DETAILED SYLLABUS

Contents: Theory

| Unit | Name of the Topic | Hours |
|---|---|---|
| I | **MECHANISMS AND TYPES OF CORROSION**<br>Definition of corrosion, Classification of corrosion, Polarization, Passivity, Principles of direct and Electro chemical Corrosion, Hydrogen evolution and Oxygen absorption mechanisms – Galvanic corrosion, Galvanic series-specific types of corrosion such as uniform, Pitting, Intergranular, Cavitations, Crevice Fretting, Erosion and Stress Corrosion –Factors influencing corrosion | 14 |
| II | **TESTING AND PREVENTION OF CORROSION**<br>Corrosion testing introduction and techniques, procedures- Surface preparation, Exposure techniques, Standard expression for corrosion rate, Prevention of Corrosion Introduction, Modifications of corrosive environment – Charging mediums-Low temperature, Decreasing velocity, Removing oxygen, Charging concentration, Inhibitors – Cathodic Protection –Protective surface coatings. | 14 |
| III | **CORROSION BEHAVIOR OF MATERIALS**<br>Corrosion of steels and alloy steels, Stainless steel, Aluminum and its alloys, copper and its alloys, Nickel and Titanium and its alloys, Magnesium and its alloys, Zinc and its alloys-corrosion of Polymers, Ceramics and Composite materials | 14 |
| IV | **SURFACE ENGINEERING FOR WEAR AND CORROSION RESISTANCE**<br>Diffusion Coatings –Electro and Electro less Plating –Hot dip coating –Hard facing-Metal spraying Flame and Arc processes-Conversion coating –Selection of coating for wear and Corrosion resistance. | 13 |

| Unit | Name of the Topic | Hours |
|---|---|---|
| V | **THIN LAYER ENGINEERING PROCESSES**<br>Laser and Electron Beam hardening –Effect of process variables such as power and scan speed - Physical vapor deposition, Thermal evaporation, Arc vaporization, Sputtering, Ion plating - Chemical vapor deposition – Coating of tools, TiC, TiN, $Al_2O_3$ and Diamond coating – Properties and applications of thin coatings. | **13** |

Text Book:


1. Corrosion Engineering, Fontana, G McGraw Hill, 1985.


Reference Books:


1. Manufacturing Engineering & Technology, Serope Kalpakjian, Addison Wesley Publishing Co; New York 1995.
2. Corrosion Engineering Hand Book, 3rd Edition, Schweitzer. P.A., Marcel Decker, 1996.
3. Corrosion, Hand Book 2nd edition, Winston Revie. R. Uhlig John Wiley, 2000.
4. Surface Engineering for Wear Resistance, Kenneth G.Budinski, Prentice hall, 1988.
5. ASM Metals Hand Book –Vol. 5, Surface Engineering, 1996.

DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN METALLURGY

III YEAR

M SCHEME

V SEMESTER

2015 -2016 onwards



**32655 - CNC MACHINES PRACTICAL**

CURRICULUM DEVELOPMENT CENTRE

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**

**DIPLOMA IN METALLURGY**
**M-SCHEME**
**(To be implemented to the student admitted from the Year 2015-2016 on wards)**

Course Name : DIPLOMA IN METALLURGY
Course Code : 1026
Subject Code : **3**2655
Semester : V Semester
Subject Title : **CNC MACHINES PRACTICAL**

**TEACHING AND SCHEME OF EXAMINATION:**

No of weeks per semester: 15 weeks

| Subject Title | Instructions | | Examination | | | |
|---|---|---|---|---|---|---|
| | Hours /Week | Hours /Semester | Marks | | | Duration |
| | | | Internal Assessment | Board Examination | Total | |
| CNC Machines Practical | 5 Hrs | 15 X 5 = 75 Hrs | 25 | 75 | 100 | 3 Hrs |



**OBJECTIVES:**

- Study the working principle of CNC machines
- Study the datum points and offsets.
- Differentiate incremental System with absolute system
- Study the simulation software package.
- Write program and simulate in the Lathe software and Milling software.
- Prepare a part program, edit and execute in CNC Turning centre.
- Prepare a part program, edit and execute in CNC Machining centre.
- Produce components in the CNC Turning centre and CNC Machining centre.
-

**Material:** Aluminum flat or acrylic fibre or plastic

**Note:** Print the part program from the simulation software and make the component in the CNC machine.

**Introductions (6 Hours)**

1. Study of CNC lathe, milling
2. Study of international standard G-Codes and M-Codes
3. Program writing – Turning simulator – Milling simulator, IS practice – commands – menus
4. Editing the program in the CNC machines.
5. Execute the program in the CNC machines.

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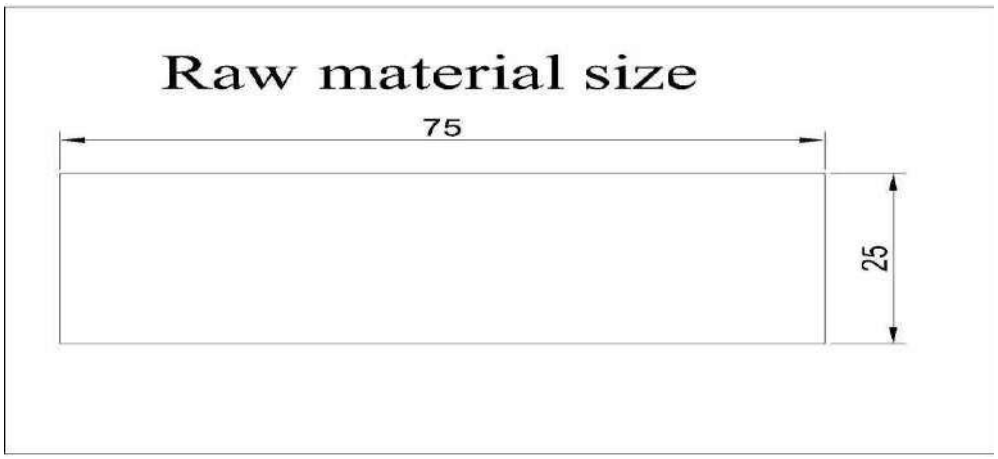
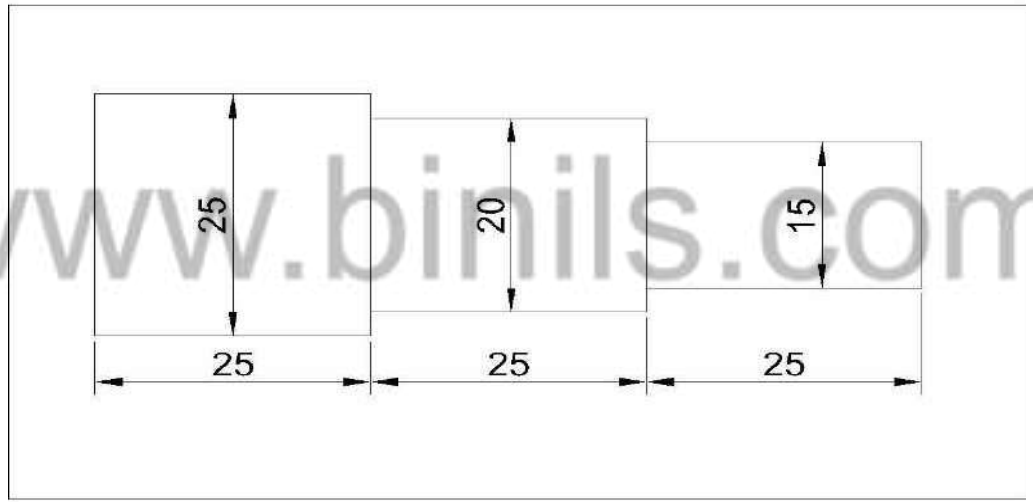
## PART – A (SIMULATION)

### CNC TURNING SIMULATION

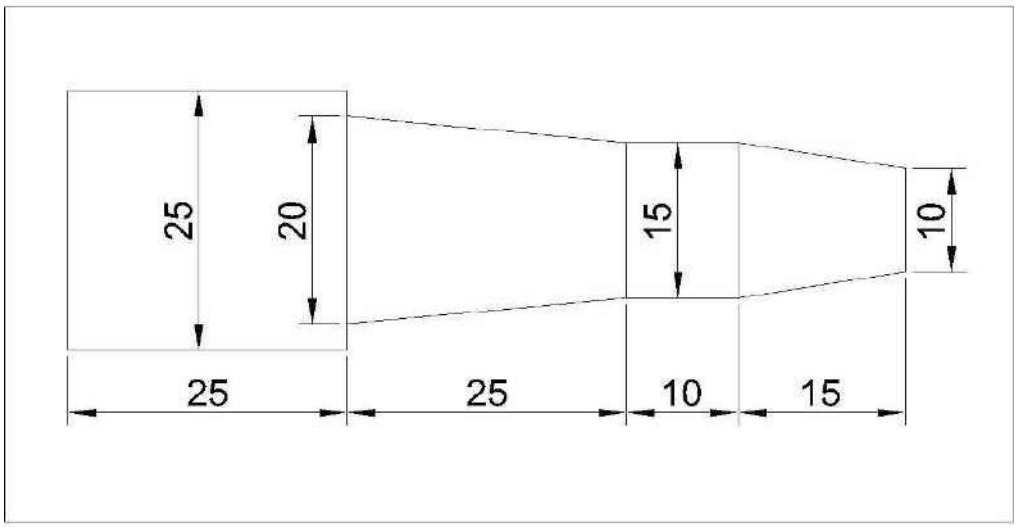



1. **Step turning using linear interpolation**

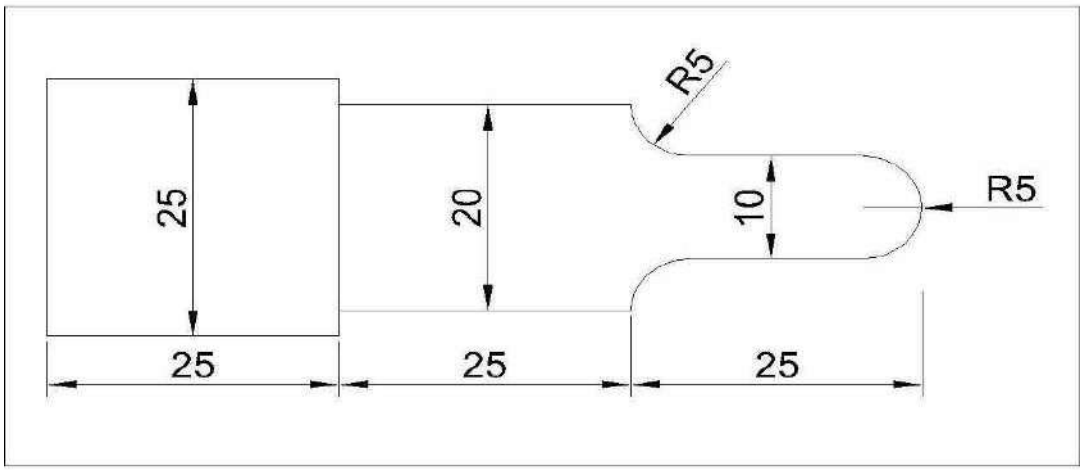




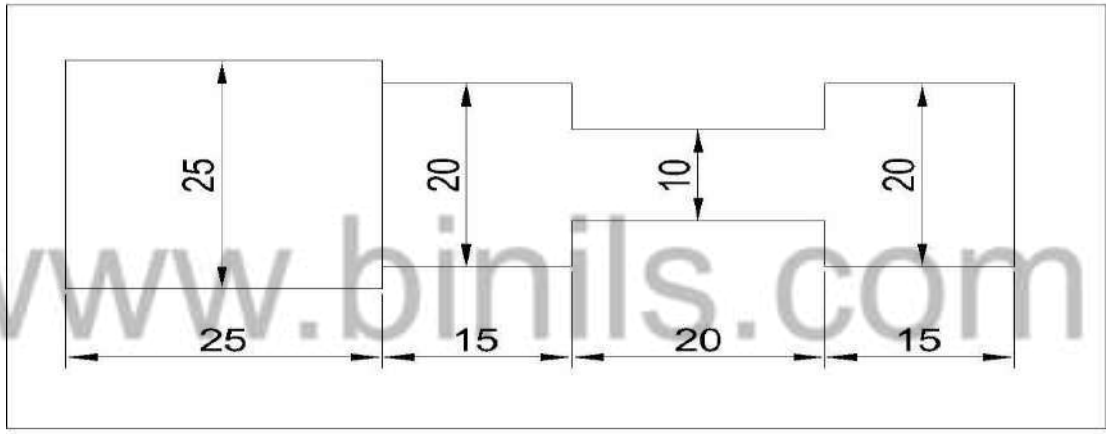

2. **Taper turning using box turning cycle**



3. **Multiple turning using circular interpolation**



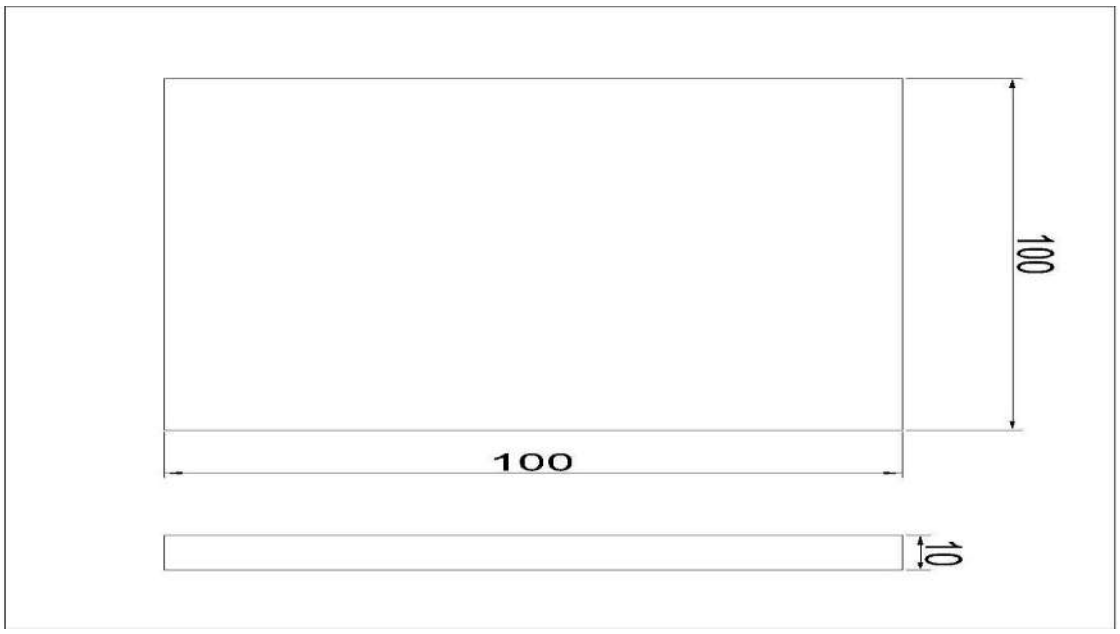

4. **Grooving using canned cycle**



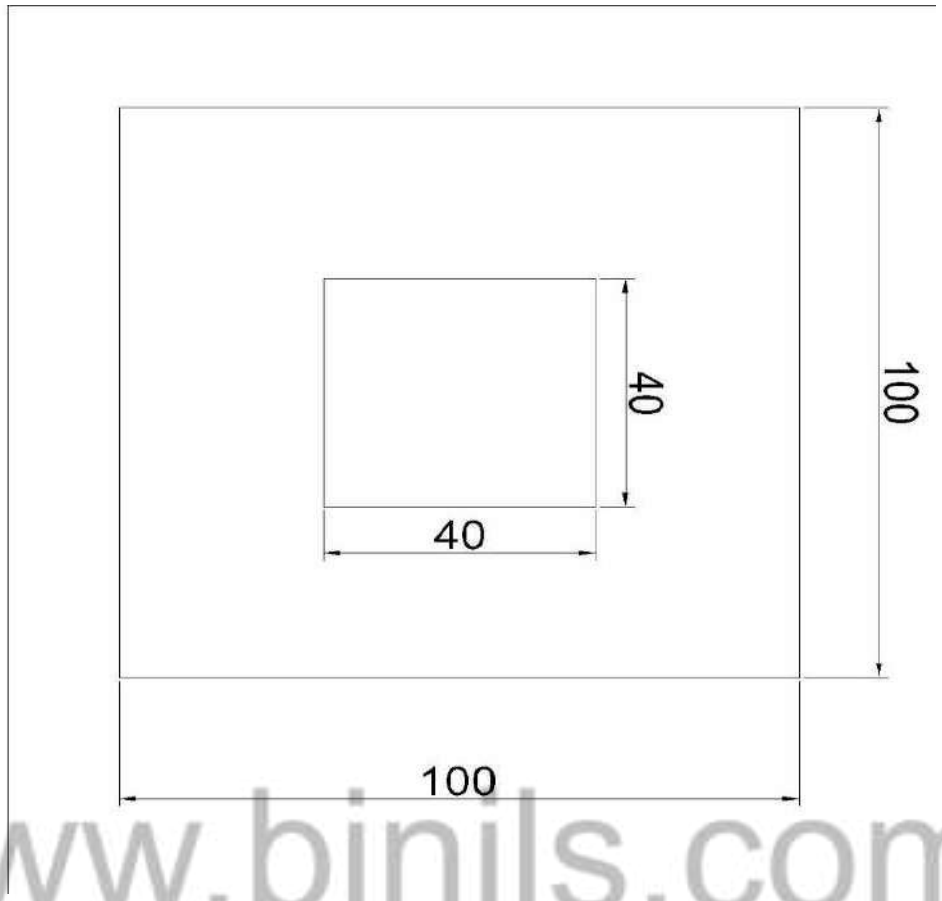



**CNC MILLING SIMULATION**

**Raw Material size**

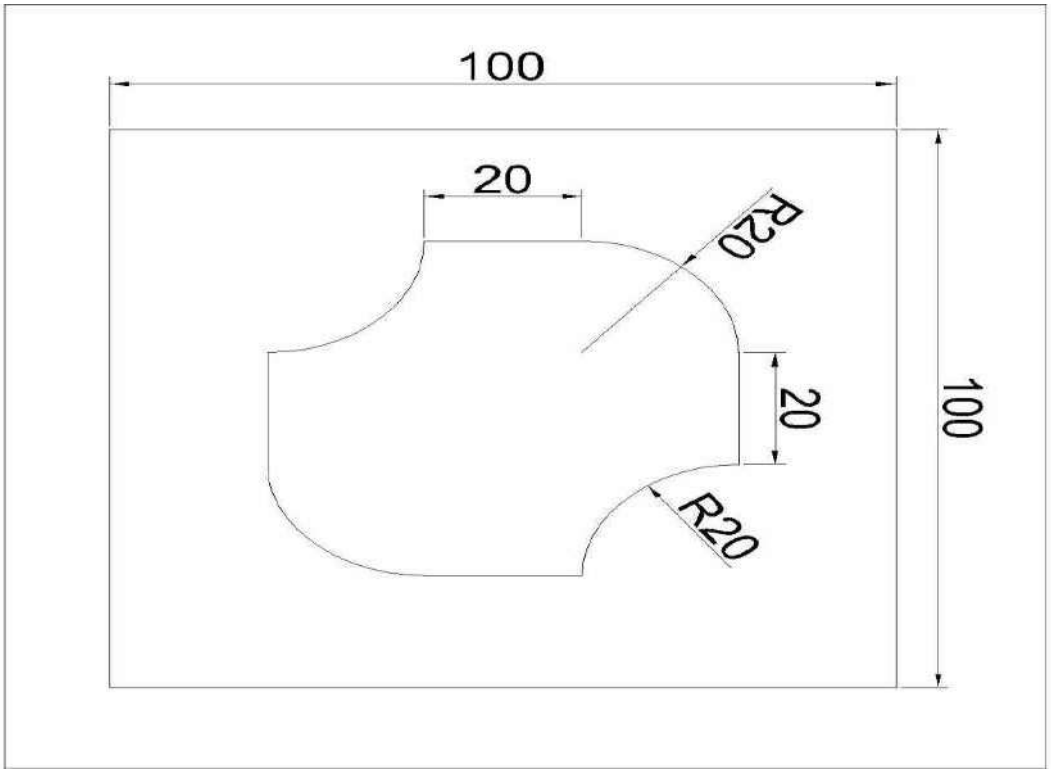


1. **Linear interpolation**

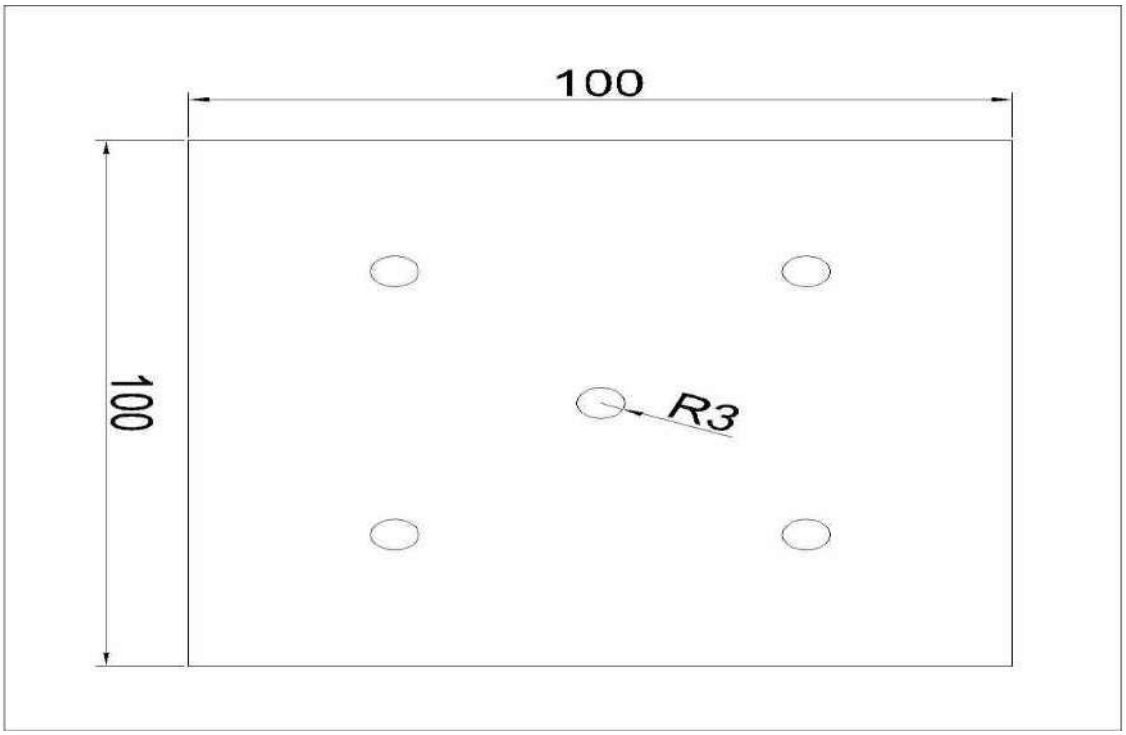





2. **Circular interpolation**

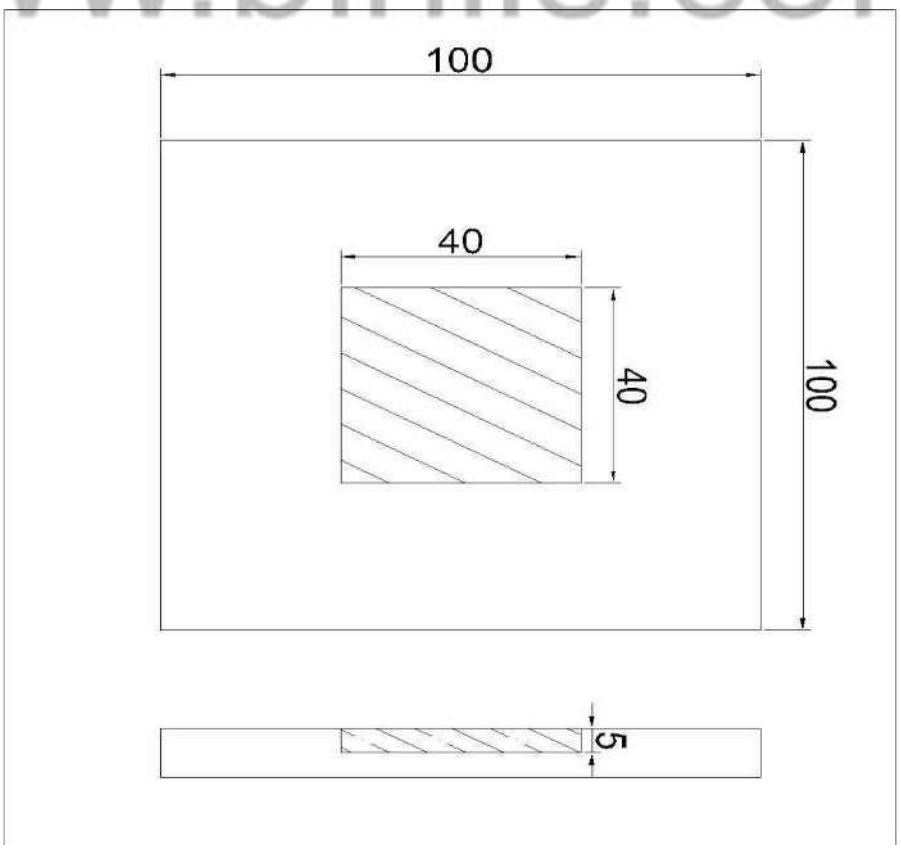


3. **Drilling**




4. **Rectangular pocketing**

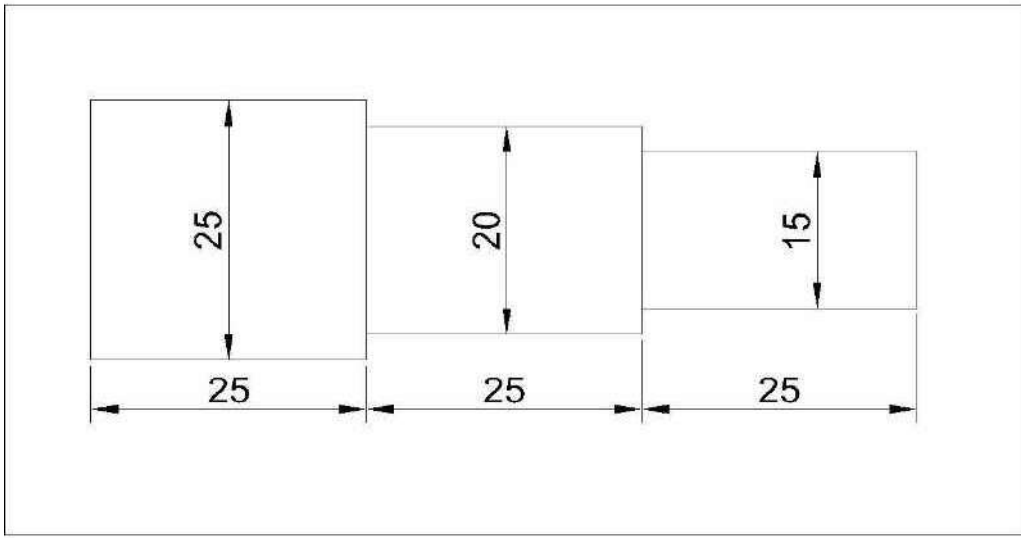




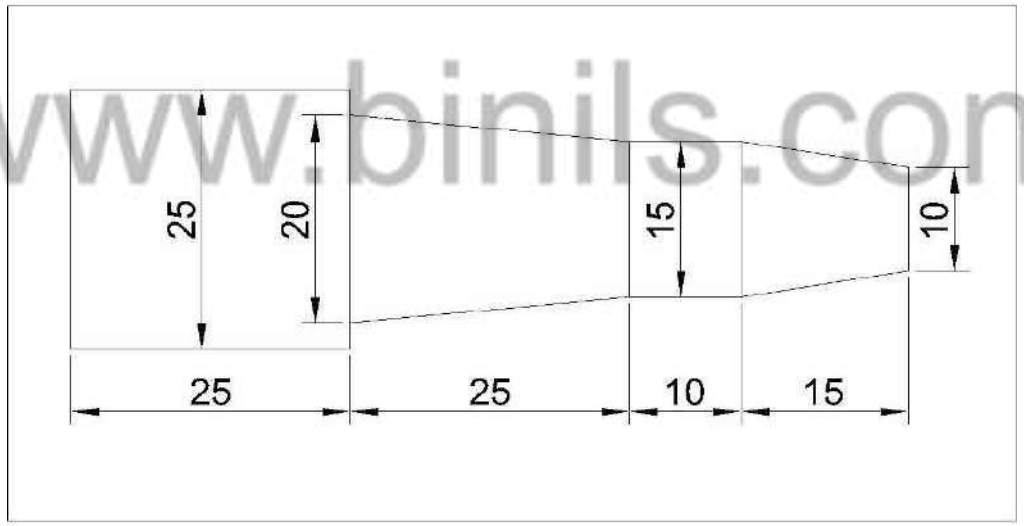
## PART – B (MACHINING)

### CNC TURNING

1. **Step turning using linear interpolation**

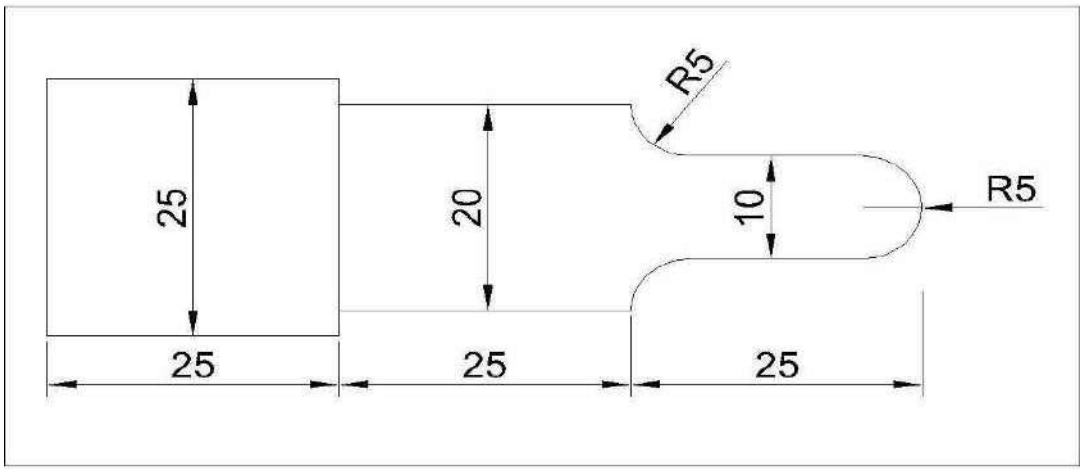



2. **Taper turning using box turning cycle**



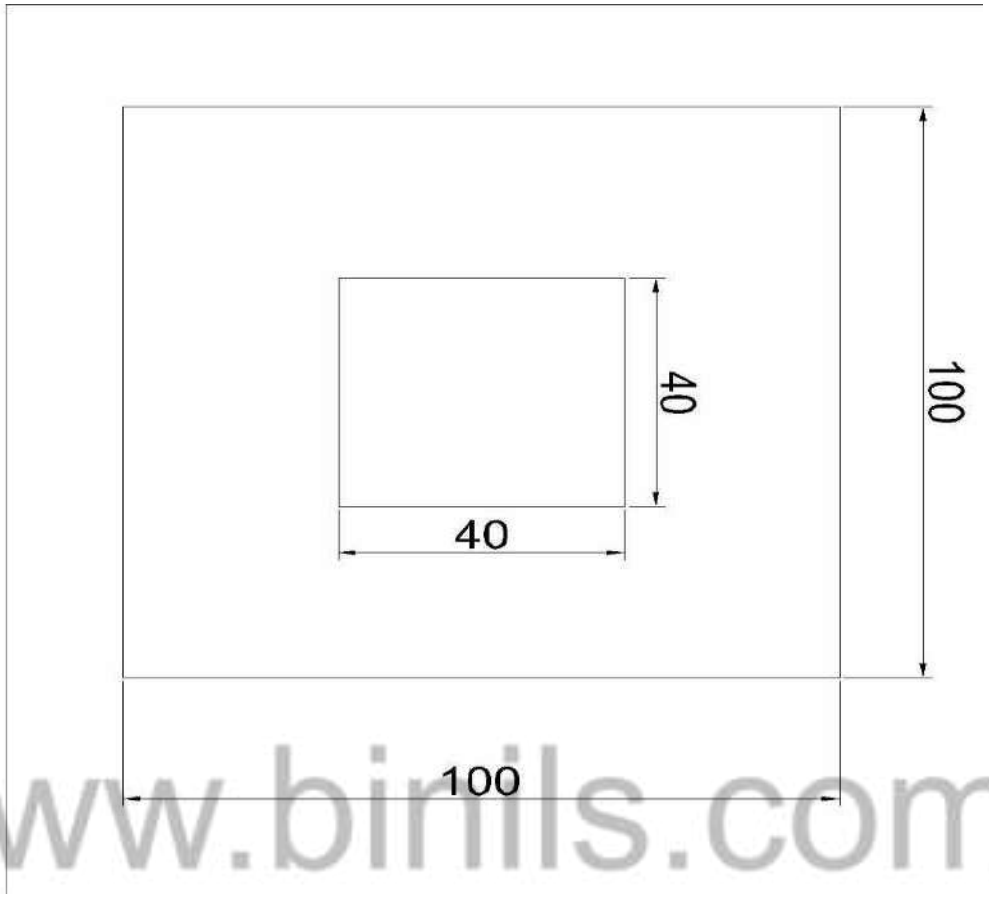



3. **Multiple turning using circular interpolation**



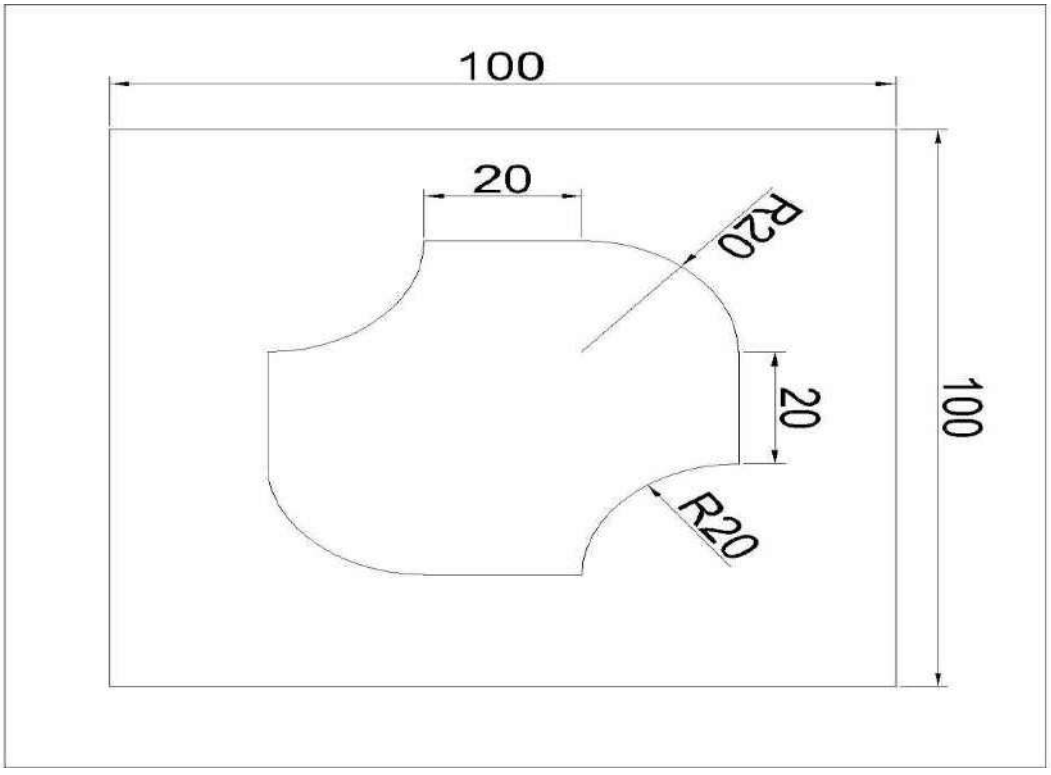
**CNC MILLING**

1. **Linear interpolation**

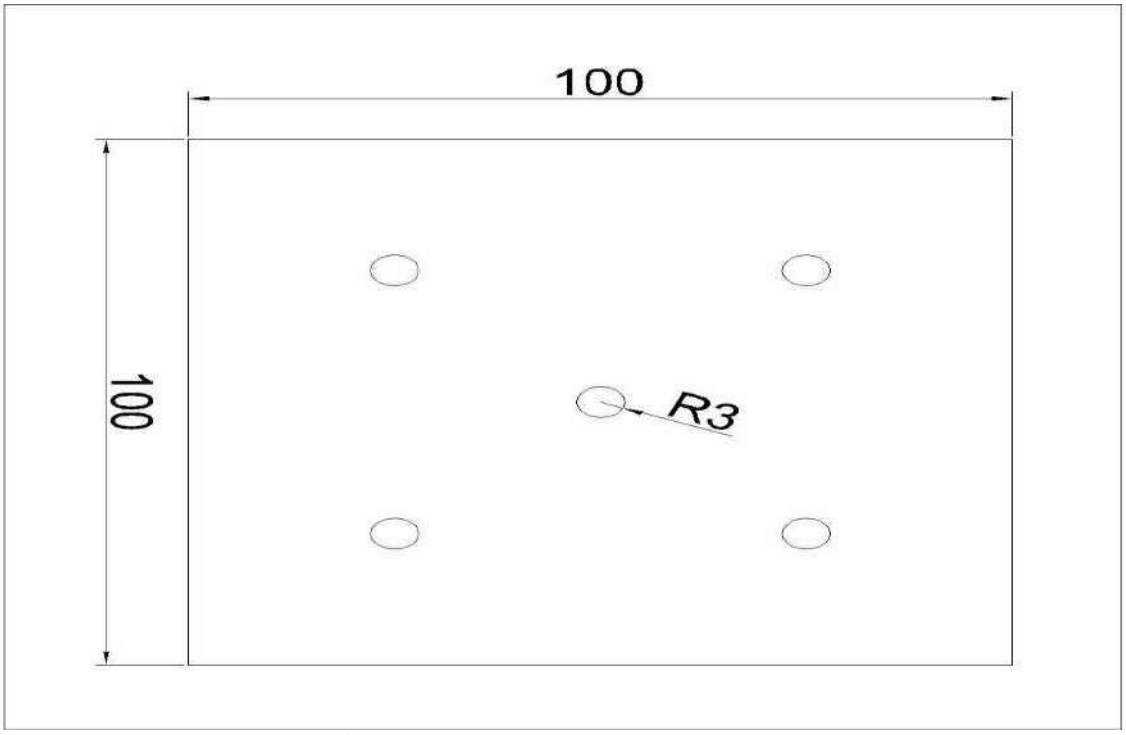





2. **Circular interpolation**



3. **Drilling**






**Revision and Test** **9 Hrs**

**BOARD EXAMINATION**

**Allocation of marks for Board Examination**

| | | |
|---|---|---|
| **PART –A** | | |
| Writing the part program | : | 20 |
| Execution/ Simulation in the software | : | 20 |
| **PART-B** | | |
| Enter and editing the program in the machine | : | 20 |
| Component machining | : | 10 |
| Viva voice | : | 5 |
| Total Marks | : | 75 |

**Minimum Facilities required for 60 intakes. Based on the intake strength the Facilities should be improved.**

1. Personal computer (Pentium processor) – 15 Nos.
2. Off line CNC Lathe and Milling simulation software – 15 users.
3. CNC Turning Machine - 2 Nos.
4. CNC Milling Machine – 2 Nos.
5. Printer – 1 No.

DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN METALLURGY

III YEAR

M SCHEME

V SEMESTER

2015 -2016 onwards



# 32656 – METAL CASTING PRACTICAL

CURRICULUM DEVELOPMENT CENTRE

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**

**DIPLOMA IN METALLURGY**
**M-SCHEME**
**(To be implemented to the student admitted from the Year 2015-2016 on wards)**

| | | |
|---|---|---|
| Course Name | **:** | DIPLOMA IN METALLURGY |
| Course Code | : | 1026 |
| Subject Code | **:** | **3**2656 |
| Semester | **:** | V Semester |
| Subject Title | **:** | **METAL CASTING PRACTICAL** |

**TEACHING AND SCHEME OF EXAMINATION:**

No of weeks per semester: 15 weeks

| Subject Title | Instructions | | Examination | | | |
|---|---|---|---|---|---|---|
| | Hours /Week | Hours /Semester | Marks | | | Duration |
| | | | Internal Assessment | Board Examination | Total | |
| Metal Casting Practical | 5 Hrs | 15 X 5 = 75 Hrs | 25 | 75 | 100 | 3 Hrs |



**RATIONALE:**

To produce defect free castings, the raw materials used in the casting process should have the required properties. These properties are determined by various experiments.

It is very much important for a Foundry Engineer to have skill to do the various experiments to determine the properties of mould materials. This lab imparts skill and training to conduct various experiments to determine the important properties required for moulding sand.

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**GUIDELINES:**

- All the experiments given in the list of experiments should be completed and given for the end semester practical examination.
- In order to develop best skills in handling Instruments/Equipment and taking readings in the practical classes, every two students should be

provided with a separate experimental setup for doing experiments in the laboratory.

- The external examiners are requested to ensure that a single experimental question should not be given to more than four students while admitting a batch of 30 students during Board Examinations.

## ALLOCATION OF MARKS

| | |
|---|---|
| Procedure | 20 marks |
| Equipment Handling | 10 marks |
| Observation and Tabulation | 25 marks |
| Calculation | 10 marks |
| Result | 05 marks |
| Viva Voce | 05 marks |
| Total | 75 Marks |

## COMPLETE LIST OF EXPERIMENTS IN DETAIL



1. Sampling
2. Preparation of standard sand specimen using sand rammer
3. Determination of Shatter Index number of the sand specimen
4. Determination of Permeability of the sand specimen
5. Determination of moisture content of sand using Speedy moisture teller
6. Determination of Clay content of the sand using clay washer
7. Determination of Mould Hardness
8. Determination of core Hardness
9. Determination of Green compression strength for the sand specimen
10. Determination of Dry compression strength for the sand specimen
11. Determination of Shear strength for the sand specimen
12. Determination of AFS grain fineness number for the sand specimen using Sieving method
13. Preparation of Mould using $CO_2$ process.
14. Determination of moisture content of sand using infrared moisture teller.
15. Preparation of cores.
16. Determination of Dry Shear strength for the sand specimen.

## LIST OF EQUIPMENTS

## AND THE QUANTITY REQUIRED FOR A BATCH OF 30 STUDENTS

| | | |
|---|---|---|
| 1 | Sampling tray | 1 No |
| 2 | Standard sand rammer. | 1 No |
| 3 | Permeability meter | 1 No |
| 4 | Universal sand testing machine | 1 No |
| 5 | Sieve shaker. | 1 No |
| 6 | Clay washer | 1 No |
| 7 | Speedy moisture teller | 1 No |
| 8 | Infrared moisture teller | 1 No |
| 9 | $Co_2$ cylinder | 1 No |
| 10 | Mould hardness tester | 1 No |
| 11 | Core hardness tester | 1 No |
| 12 | Shatter index tester | 1 No |
| 13 | Weighing balance | 1 No |
| 15 | Core boxes | 2 Nos. |
| 16 | Moulding sand | 500Kg |
| 17 | Calcium carbide | 500g |
| 18 | Sodium hydroxide | 500g |

DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN METALLURGY

III YEAR

M SCHEME

V SEMESTER

2015 -2016 onwards



**30002 - LIFE AND EMPLOYABILITY SKILLS PRACTICAL ****

CURRICULUM DEVELOPMENT CENTRE

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**

**DIPLOMA IN ENGINEERING – SYLLABUS – M Scheme**

(Being implemented from the Academic Year 2016-2017 onwards)

Course Name : **All Branches of Diploma in Engineering and Technology and Special Programmes**

Subject Code : **30002**

Semester : **V**

Subject Title : **LIFE AND EMPLOYABILITY SKILLS PRACTICAL**

**Teaching and Scheme of Examination:** **No. of Weeks per Semester: 15 Weeks**

| Subject | Instruction | | Examination | | | |
|---|---|---|---|---|---|---|
| | | | Marks | | | |
| | Hours/ Week | Hours/ Semester | Internal assessment | Board Examination | Total | Duration |
| Life and Employability Skills | 4 Hours | 60 Hours | 25 | 75 | 100 | 3 Hours |



**Topics and Allocation of Hours:**

| Sl. No. | Section | No. of Hours |
|---|---|---|
| **1** | **Part – A**<br>Communication | **30** |
| **2** | **Part – B**<br>Entrepreneurship, Project Preparation, Productivity, | **20** |

| | | |
|---|---|---|
| | Occupational Safety, Health, Hazard, Quality Tools& Labour Welfare | |
| **3** | **Part – C**<br><br>Environment, Global Warming, Pollution | **10** |
| **TOTAL** | | **60** |

**RATIONALE**

Against the backdrop of the needs of the Industries, as wells as based on fulfilling the expectations of the Industries, the Diploma Level students have to be trained directly and indirectly in toning up their competency levels. Proficiency in Communication only, equips them with confidence and capacity to cope with the employment. Hence, there is a necessity to focus on these in the curriculum. At the end of the Course, the student is better equipped to express himself in oral and written communication effectively.

**SPECIFIC INSTRUCTIONAL OBJECTIVES**



**1. Emphasize and Enhance Speaking Skills**

**2. Increase Ability to Express Views & Opinions**

**3. Develop and Enhance Employability Skills**

**4. Induce Entrepreneurship and Plan for the Future**

**5. Expose & Induce Life Skills for Effective Managerial Ability**

**LIFE AND EMPLOYABILITY SKILLS PRACTICAL**

**SYLLABUS**

| Unit | Topics | Activity | Hours |
|---|---|---|---|
| I | **Communication, Listening, Training, Facing Interviews, Behavioural Skills** | -- instant sentence making<br>– say expressions/phrases-- self- introduction/another higher official in company<br>– describe/explain product<br>– frame questions based on patterns<br>– make sentences based on patterns | **30** |
| II | **Entrepreneurship, Project Preparation, Marketing Analysis, Support & Procurement** | -- prepare an outline of a project to obtain loan from bank in becoming an entrepreneur<br>– prepare a resume | **10** |
| III | **Productivity – comparison with developed countries, Quality Tools, Circles, Consciousness, Management, House Keeping** | -- search in the website<br>-- prepare a presentation<br>– discuss & interact | **05** |
| IV | **Occupational Safety, Health Hazard, Accident & Safety, First-Aid,Labour Welfare Legislation, Welfare Acts** | -- search in the website<br>-- prepare a presentation<br>– discuss & interact | **05** |

| | | | |
|---|---|---|---|
| **V** | **Environment, Global Warming, Pollution** | -- taking down notes / hints – answering questions<br><br>-- fill in blanks the exact words heard | **10** |

**LEARNING STRUCTURE** **100 Marks**

**-- Focus more on Speaking & Listening Skills**
**-- Attention less on Reading & Writing Skills**
**-- Apply the skills in fulfilling the Objectives on Focused Topics**

**a) Listening** **25 Marks**

1. Deductive Reasoning Skills (taking down notes/hints) **10**
2. Cognitive Skills (answering questions) **10**
3. Retention Skills (filling in blanks with exact words heard) **05**

**b) Speaking Extempore/ Prepared** **30 Marks**

1. Personality/Psychological Skills (instant sentence making) **05**
2. Pleasing & Amiable Skills (say in phrases/expressions) **05**
3. Assertive Skills (introducing oneself/others) **05**
4. Expressive Skills (describe/explain things) **05**
5. Fluency/Compatibility Skills (dialogue) **05**
6. Leadership/Team Spirit Skills (group discussion) **05**

**c) Writing & Reading** **20 Marks**



1. Creative & Reasoning Skills (frame questions on patterns) **05**
2. Creative & Composing Skills (make sentences on patterns) **05**
3. Attitude & Aim Skills (prepare resume) **05**
4. Entrepreneurship Skills (prepare outline of a project) **05**

**d) Continuous Assessment (Internal Marks)** **25 Marks**

(search,read, write down, speak, listen, interact & discuss)

1. Cognitive Skills (Google search on focused topics)
2. Presentation Skills& Interactive Skills (after listening, discuss)

**Note down and present in the Record Note on any 5 topics** **10 Marks**
**Other activities recorded in the Record note** **10 Marks**
**Attendance** **05 Marks**

**INTERNAL MARKS** **25 MARKS**

**EXTERNAL MARKS AT END EXAMINATION** **75 MARKS**

**MODEL QUESTION**

**Time: 3 Hours** **Maximum Marks: 75**

**A. LISTENING** **25 Marks**

1. Listen to the content and take down notes/hints 10
2. Listen to the content and answer the following questions. 10
3. Listen to the content and fill in the blanks the exact words heard. 05

**B. SPEAKING** **30 Marks**

1. Say in a sentence instantly on hearing the word(5 words, one after another). 05
2. Say any five expressions commonly used in communication. 05
3. Imagine, a consultant has come to your department.
   Introduce him to your subordinates. 05
4. Explain/describe the product you are about to launch in the market. 05
5. Speak with your immediate boss about the progress you have made. 05
6. Discuss within the group on the topic of focus in the syllabus. 05

**C. WRITING & READING** **20 Marks**



1. Frame new questions from the pattern given by changing sets of words with your own. 05

| | | | | |
|---|---|---|---|---|
| a. | When | do | you | return? |
| b. | How | is | his performance? | |
| c. | Where | has | the manager | gone? |
| d. | What | is | the progress | today? |
| e. | Why | are | the machines | not functioning? |

2. Make sentences from the pattern given by changing sets of words with your own. 05

| | | | | | |
|---|---|---|---|---|---|
| a. | The workers | are | on strike | | |
| b. | The labourers | are paid | well | in this factory | |
| c. | There | is | a rest room | for the workers | |
| d. | These | are | the new products | launched | by our company |
| e. | Almost everyone | come | to the company | on motorbikes | |

3. Prepare a resume for the post of Department Manager. 05

4. Prepare an outline of a project to obtain a loan. (Provide headings and subheadings) 05

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**I. Guidelines for setting the question paper:**



**A. LISTENING :**

ONLY TOPICS related to
POLLUTION /
ENVIRONMENT /
GLOBAL WARMING are to be taken.
These topics are common for all the three types of evaluation.

**B. SPEAKING :**

1. WORDS of common usage
2. Fragments – expression of politeness, courtesy, cordiality
3. Introduce yourself as an engineer with designation or
   Introduce the official visiting your company/department

4. Describe/Explain the product/machine/department
5. Dialogue must be with someone in the place of work.
6. Group of six/eight
   Discuss the focused topic prescribed in syllabus

**C. WRITING & READING:**

1. Provide five different structures.
   Students are to substitute at least one with some other word/words

2. Provide five different structures.
Students are to substitute at least one with some other word/words
3. Provide some post related to industries.
4. Outline of the project (skeleton/structure)
Only the various headings and subheadings
Content is not needed

**II. Guidelines for recording the material on the Focused Topics in the Record note.**

Write in the record note, **on any five topics**, from the list of topics given below. **10 Marks**
**(**5 topics x 10 marks = 50 marks. Thus, the **Average of 5 topics is 10 Marks)**

1. Productivity in Industries – Comparison with developed countries
2. Quality Tools, Quality Circles and Quality Consciousness
3. Effective Management
4. House Keeping in Industries
5. Occupational Safety and Hazard
6. Occupational Accident and First Aid
7. Labour Welfare Legislations
8. Labour Welfare Acts and Rights
9. Entrepreneurship
10. Marketing Analysis, Support and Procurement

**LABORATORY REQUIREMENT:**



1. An echo-free room
2. Necessary furniture and comfortable chairs
3. A minimum of two Computers with internet access
4.A minimum of two different English dailies
5. A minimum of Three Mikes with and without cords
6. Colour Television (minimum size – 29")
7. DVD/VCD Player with Home Theatre speakers
8. Smart board
9. Projector

**Suggested Reading:**

1. Production and Operations Management by S.N. Chary, TMH
2. Essentials of Management by Koontz &Weihrich, TMH
3. Modern Production / Operations Management by E.S. Buffa and R.K. Sarin, John Wiley & Sons
4. Production Systems: Planning, Analysis and Control by J.L.Riggs, 3rd ed., Wiley.
5. Productions and Operations Management by A.Muhlemann, J.Oakland and K.Lockyer, Macmillan
6. Operations Research - An Introduction by H.A.Taha, Prentice Hall of India
7. Operations Research by J.K.Sharma, Macmillan
8. Business Correspondence & Report Writing by R.C. Sharma and K.Mohan, TMH
9. How to prepare for Group Discussion & Interview (With Audio Cassette) by Prasad, TMH

10. Spoken English – A self-learning guide to conversation practice (with Cassette)
11. Introduction to Environmental Engineering by Mackenzie, L. Davis and A. David, Cornwell, McgrawHill, 3rd Ed.
12. Environmental Engineering by Peary, Rowe and Tchobanoglous, McgrawHill
13. Total Quality Management – An Introductory Text by Paul James, Prentice Hall
14. Quality Control and Applications by Housen&Ghose
15. Industrial Engineering Management by O.P. Khanna

# VI SEMESTER

DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN METALLURGY

III YEAR

M SCHEME

VI SEMESTER



2015 -2016 onwards

**32061 – INDUSTRIAL ENGINEERING AND MANAGEMENT ***

CURRICULUM DEVELOPMENT CENTRE

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**
**DIPLOMA IN METALLURGY**
**M-SCHEME**
**(To be implemented to the student admitted from the Year 2015-2016 on wards)**

Course Name : DIPLOMA IN METALLURGY
Course Code : 1026
Subject Code : 32061
Semester : VI Semester
Subject Title : Industrial Engineering and Management

**TEACHING AND SCHEME OF EXAMINATIONS:**

No. of Weeks per Semester: 15 Weeks

| Subject | Instructions | | Examination | | | |
|---|---|---|---|---|---|---|
| Industrial Engineering and Management | **Hours/ Week** | **Hours/ Semester** | **Marks** | | | **Duration** |
| | 6 | 90 | **Internal Assessment** | **Board Examination** | **Total** | 3 Hours |
| | | | 25 | 75 | 100 | |



**Topics and Allocation of Hours:**

| UNIT NO. | TOPIC | HOURS |
|---|---|---|
| I | PLANT ENGINEERING AND PLANT SAFETY | 17 |
| II | WORK STUDY, METHOD STUDY AND WORK MEASUREMENT | 17 |
| III | PRODUCTION PLANNING AND QUALITY CONTROL | 17 |
| IV | PRINCIPLES, PERSONNEL MANAGEMENT AND ORGANIZATIOAL BEHAVIOR: | 16 |
| V | FINANCIAL AND MATERIAL MANAGEMENT | 16 |
| | REVISION AND TEST | 7 |
| | **TOTAL** | **90** |

**RATIONALE:**

In the Indian Economy, Industries and Enterprises always find prominent place. After globalization, the students should be trained not only in manufacturing processes but also in managing activities of industries. The knowledge about plant, safety, work study techniques, personnel management and financial management will definitely mould the students as managers to suit the industries.

**OBJECTIVES:**

- To study the different types of layout.
- To study the safety aspects and its impacts on an organization.
- To study different work measurement techniques.
- To study production planning and control and its functions.
- To study basic and modern management techniques.
- To study the staff selection procedure and training of them.
- To study capital and resources of capital.
- To study inventory control system.
- To study about organization and it's behavior.



**INDUSTRIAL ENGINEERING AND MANAGEMENT**
**DETAILED SYLLABUS**

**Contents: Theory**

| UNIT | NAME OF THE TOPIC | HOURS |
|---|---|---|
| I | **PLANT ENGINEERING AND PLANT SAFETY** | **17** |
| | **Plant Engineering :** Plant – Selection of site of industry – Plant layout – Principles of a good layout – types – process, product and fixed position – techniques to improve layout – Principles of material handling equipment – Plant maintenance – importance – Break down maintenance, preventive maintenance and scheduled maintenance. | |
| | **Plant Safety:** Importance –accident-causes and cost of an accident-accident proneness-prevention of accidents-Industrial disputes-settlement of Industrial disputes-Collective bargaining, conciliation, Mediation, arbitration-Indian Factories Act 1948 and its provisions related to health, welfare and safety. | |

| | | |
|---|---|---|
| II | **WORK STUDY, METHOD STUDY AND WORK MEASUREMENT** | **17** |

**Work Study:** Productivity – Standard of living – method of improving productivity

– Objectives – Importance of good working conditions.

**Method Study:** Definition – Objectives – Selection of a job for method study –Basic procedure for conduct of method study – Tools used – Operation process chart, Flow process chart, two handed process chart, Man machine chart, String diagram and flow diagram.

**Work Measurement:** Definition – Basic procedure in making a time study – Employees rating factor – Application of time allowances – Rest, Personal, Process, Special and Policy allowances – Calculation of standard time – Problems – Basic concept of production study – Techniques of work measurement-Ratio delay study, Synthesis from standard data, analytical estimating and Pre determined Motion Time System (PMTS).

| | | |
|---|---|---|
| III | **PRODUCTION PLANNING AND QUALITY CONTROL** | **17** |



**Production Planning and Control:** Introduction – Major functions of production planning and control – Pre planning – Methods of forecasting – Routing and scheduling – Dispatching and controlling – Concept of Critical Path Method (CPM)-Description only. Production – types-Mass production, batch production and job order production- Characteristics – Economic Batch Quantity (EBQ) – Principles of product and process planning – make or buy decision.

**Quality Control:** Definition – Objectives – Types of inspection – First piece, Floor and centralized inspection – Advantages and disadvantages. Quality control – Statistical quality control – Types of measurements – Method of variables – Method of attributes – Uses of X, R, p and c charts – Operating Characteristics curve (O.C curve) – Sampling inspection – single and double sampling plan – Concept of ISO 9001:2008 Quality Management System Registration Certification procedure – Benefits of ISO to the organization.

| | | |
|---|---|---|
| IV | **PRINCIPLES, PERSONNEL MANAGEMENT AND ORGANIZATIOAL BEHAVIOR:** | 16 |

**Principles of Management:** Definition of management – Administration - Organization – F.W. Taylor's and Henry Fayol's Principles of Management – Functions of Manager – Directing – Leadership -Styles of Leadership – Qualities of a good leader – Motivation – Positive and negative motivation --Modern management techniques- Just In Time – Total Quality Management (TQM) – Quality circle – Zero defect concept – 5S Concept- Management Information Systems – Strategic management – SWOT Analysis --Business Process Re-engineering (BPR) – Enterprises Resource Planning (ERP) –Supply Chain Management (SCM) – Activity Based Management (ABM) – Global Perspective – Principles and brief describtion.

**Personnel Management:** Responsibility of human resource management – Selection procedure – Training of workers – Apprentice training – On the job training and vestibule school training – Job evaluation and merit rating – objectives and importance – wages and salary administration – Components of wages – Wage fixation – Type of wage payment – Halsey's 50% plan, Rowan's plan and Emerson's efficiency plan – Problems.



**Organizational behavior:** Definition – organization--Types of Organization – Line, Staff,Taylor's Pure functional types – Line and staff and committee type –Organizational Approaches, individual behavior—causes—Environmental effect—Behavior and Performance, Perception-organizational implications.

| | | |
|---|---|---|
| V | **FINANCIAL AND MATERIAL MANAGEMENT** | 16 |

**Financial Management:** Fixed and working capital – Resources of capital – shares preference and equity shares – debentures – Type of debentures – Public deposits, Factory costing – direct cost – indirect cost – Factory overhead – Selling price of a product – Profit – Problems. Depreciation – Causes – Methods - Straight line, sinking fund and percentage on diminishing value method – Problems.

**Material management:** Objectives of good stock control system – ABC analysis of inventory – Procurement and consumption cycle – Minimum Stock, Lead Time, Reorder Level-Economic order quantity problems – supply chain management – Introduction – Purchasing procedure – Store keeping – Bin card.

**Text Books :**


1) Industrial Engineering and Management, O.P. Khanna, Revised Edition Publications (P) Ltd – 2004, 67/4 Madras House, Daryaganj, New Delhi – 110002.
2) Engineering Economics and Management, T.R. Banga & S.C. Sharma, McGraw Hill Editiion. 2 – 2001, New Delhi.
3) Herald Koontz and Heinz Weihrich,'Essentials of Management',McGraw Hill Publishing Company,Singapore International Edition.Latest


**Reference Books :**




1) Management, A global perspective, Heinz Weihrich, Harold Koontz, 10th Edition, McGraw Hill International Edition.Latest.
2) Essentials of Management, 4th Edition, Joseph L.Massie, Prentice-Hall of India, New Delhi 2004.
3) S.Chandran,Organizational Behaviours,Vikas Publishing House Pvt. Ltd. Latest
4) M.Govindarajan and S.Natarajan,Principles of Management,Prentce Hall of India Pvt.Ltd.New Delhi.Latest.

DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN METALLURGY

III YEAR

M SCHEME

VI SEMESTER



2015 -2016 onwards

# 32662 – POWDER METALLURGY

CURRICULUM DEVELOPMENT CENTRE

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**
**DIPLOMA IN METALLURGY**
**M-SCHEME**
**(To be implemented to the student admitted from the Year 2015-2016 on wards)**

Course Name : DIPLOMA IN METALLURGY
Course Code : 1026
Subject Code : **3**2662
Semester : VI Semester
Subject Title : **POWDER METALLURGY**

**TEACHING AND SCHEME OF EXAMINATION:**

No of weeks per semester: 15 weeks

| Subject Title | Instructions | | Examination | | | |
|---|---|---|---|---|---|---|
| | Hours /Week | Hours /Semester | Marks | | | Duration |
| | | | Internal Assessment | Board Examination | Total | |
| Powder Metallurgy | 5 Hrs | 15 X 5 = 75 Hrs. | 25 | 75 | 100 | 3 Hrs |



**Topics and Allocation of Hours:**

| Sl.No. | Topic | Time(Hrs) |
|---|---|---|
| 1. | Powder Characteristics & Testing | 14 |
| 2. | Powder Manufacturing Methods | 14 |
| 3. | Powder conditioning & compaction techniques | 14 |
| 4. | Sintering | 12 |
| 5. | Production of specific P/M parts | 14 |
| | Revision and Test | 7 |
| TOTAL | | 75 |

**RATIONALE:**

Modern world's need is to develop methods to manufacture net shape or near net shaped articles and components of different materials with reduced post machining processes, high degree of dimensional accuracies, superior properties at low cost, superior performance requirements and High quality. This subject will be an introduction level to students to know about various powder manufacturing methods, processing routes, different compacting techniques and suitable sintering practices to result in high quality components free from defects with superior performance in application.

**OBJECTIVES:**

- At the end of this unit the student will learn the principles of powder Metallurgy
- Various properties & testing methods will give an idea about how to produce a good powder metallurgy component
- Understands Various specific manufacturing methods for metal powders
- Understands the controlling variables to produce good quality powder
- Get knowledge about the conditioning of powder
- Will provide the selection of appropriate method to yield sound compacts of higher density
- Various types of Sintering techniques will be learnt
- How to produce dense component by controlling sintering variables will be understood
- This gives the production methods of some specific parts using Powder Metallurgy technique

## 32662. POWDER METALLURGY

DETAILED SYLLABUS

Contents: Theory

| Unit | Name of the Topic | Hours |
|---|---|---|
| I | **POWDER CHARECTERISTICS & TESTING**<br>Introduction<br>Advantages and limitations<br>Applications in various engineering fields<br>Properties and testing of powders<br>Sampling methods<br>Chemical composition<br>Particles Size Measurement by<br>Sieve analysis<br>Microscopic<br>Sedimentation<br>Elutriation<br>Permeability<br>Adsorption<br>Particles shape,<br>Particle Microstructure<br>Surface area<br>Tap density<br>Green density<br>Apparent density<br>Flow rate<br>Pressing properties: Compressibility and Compactibility<br>Green strengths<br>Green spring<br>Properties of Sintered compact. | 14 |
| II | **POWDER MANUFACTURING METHODS**<br>Mechanical processes:<br>Machining<br>Crushing<br>Milling: Ball Mill<br>Hametag Eddy Mill | 14 |

| | | |
|---|---|---|
| | Shotting<br>Graining<br>Atomization: DPG process<br>Mannesmann processes<br>Rotary atomization<br>Soluble gas<br>Cold stream process<br>Physico-Chemical processes<br>Condensation<br>Thermal decomposition<br>Reduction<br>Electro deposition<br>Precipitation from aqueous solution<br>Hydrometallurgical process<br>Inter-granular corrosion | |
| **III** | **POWDER CONDITIONING & COMPACTION TECHNIQUE**<br><br>Powder conditioning<br>Preliminary Heat Treatment<br>Powder Blending and Mixing<br>Compaction<br>Pressure-less Shaping Technique<br>Loose sintering<br>Slip casting<br>Slurry casting<br>Cold Pressure Shaping Technique<br>Die compaction - basic Principles<br>Sizing and Coining<br>Iso-static pressing<br>Explosive forming<br>High Energy Rate Forming (HERF)<br>Roll compaction<br>Cycle compaction<br>Vibratory and Centrifugal compaction<br>Powder Extrusion<br>Pressure Shaping Technique with Heat<br>Hot pressing<br>Powder or Sinter Forging<br>Hot Extrusion<br>Hot Rolling<br>Hot Iso-static compaction | **14** |

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| | | |
| **IV** | **SINTERING**<br>Introduction<br>Property changes<br>Stages of Sintering<br>Mechanisms of Sintering - Basics<br>Liquid Phase Sintering<br>Infiltration process<br>Sintering Furnace<br>Zones, Batch type, Continuous type<br>Oil fired ,Electrically heated<br>Sintering Furnace Atmospheres:<br>Hydrogen, Dissociated or Cracked Ammonia<br>Exothermic gases , Endothermic gases<br>Argon and Helium | **12** |
| **V** | **PRODUCTON OF SPECIFIC P/M PARTS**<br>Production of bearings:<br>Types of bearing materials: Types alone<br>Method of production, Application of bearings.<br>Sintered Friction Materials<br>Friction material formulation, Production<br>Properties, Application<br>Tool Materials:<br>Production of cemented carbides<br>Production of carbide - Tipped tools<br>Production of oxide tools<br>Production of boride tools<br>Production of diamond tools and | **14** |

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|---|---|---|
| | Applications<br>Cermets:<br>Production of Cermets, Applications<br>Dispersion Strengthened Materials:<br>Production, Applications<br>Finishing operations:<br>Carburizing, Carbonitriding, Nitriding<br>Through Hardening, Induction Hardening<br>Precipitation Hardening | |

**Text Book:**

1. Powder Metallurgy, Anilkumar Sinha, Dhanpat Rai & Sons.
2. Powder Metallurgy, P.C. Angelo & R. Subramanian, PHI Learning Private Limited, New Delhi.

**Reference Books:**



1. Powder Metallurgy Opportunities for Engg. Industries, P. Ramakrishnan, Oxford & IBH Pub. Co.Ltd.,
2. Powder Metallurgy, Sands and Shakespeare, George Newness Limited, London
3. Introduction to Powder Metallurgy, Joel S. Hirsch horn, American Powder Metallurgy Institute, Princeton, New Jersey.
4. A.S.M. Metals Handbook Vol.7

DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN METALLURGY

III YEAR

M SCHEME

VI SEMESTER

2015 -2016 onwards



# 32681 – SELECTION OF MATERIALS

CURRICULUM DEVELOPMENT CENTRE

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**

**DIPLOMA IN METALLURGY**
**M-SCHEME**
**(To be implemented to the student admitted from the Year 2015-2016 on wards)**

Course Name : DIPLOMA IN METALLURGY
Course Code : 1026
Subject Code : **3**2681
Semester : VI Semester
Subject Title : **SELECTION OF MATERIALS**

**TEACHING AND SCHEME OF EXAMINATION:**

No of weeks per semester: 15 weeks

| Subject Title | Instructions | | Examination | | | |
|---|---|---|---|---|---|---|
| | Hours /Week | Hours /Semester | Marks | | | Duration |
| | | | Internal Assessment | Board Examination | Total | |
| Selection Of Materials | 5 Hrs | 15 X 5 = 75 Hrs | 25 | 75 | 100 | 3 Hrs |



**Topics and Allocation of Hours:**

| Unit No | Topic | Time(Hrs) |
|---|---|---|
| I | Classification and properties of materials, Engineering material selection criteria | 14 |
| II | Study about corrosion, and Corrosion resistance materials, prevention methods | 14 |
| III | High temperature and low temperature materials, Super alloys | 14 |
| IV | Wear resistance materials, friction and Impact resistance materials, bearings | 13 |
| V | Electrical, magnetic materials, Materials for Nuclear Engineering | 13 |
| | Revision and Test | 7 |
| TOTAL | | 75 |

**RATIONALE:**

The selection of material most suitable for a particular component of a machine is a very important function of material engineer. To select most suitable material for a given application one who thoroughly knows a properties and behaviour of materials.

To this, the various properties of engineering material, criteria for selection and factors affecting engineering material selection are in first unit. Corrosion engineering and corrosion resistance material are in 2nd unit and high, low temperature, electrical and magnetic and nuclear engineering materials are in 3rd, 4th and 5th unit respectively. By studying this subject one who can easy to suggest the most suitable material.

**OBJECTIVES:**

At the end of the study of VI Semester the student will be able to

- To know the properties of engineering materials
- To know the selection criteria for engineering materials.
- Study about corrosion – its types and prevention methods.
- Learn about the corrosion resistant alloys.
- Study about the high temperature and low temperature materials.
- Learn about friction materials and its properties.
- Learn about the impact and bearing materials.
- Learn about the electrically conductive and resistance materials
- Study about the magnetic materials.
- To know about the materials used for Nuclear Engineering.

## 32681. SELECTION OF MATERIALS

DETAILED SYLLABUS

Contents: Theory

| Unit | Name of the Topic | Hours |
|---|---|---|
| I | **CLASSIFICATION AND PROPERTIES OF MATERIALS, ENGINEERING MATERIAL SELECTION CRITERIA**<br><br>Material Classification: Metals, Ceramics, organics and their characteristics.<br>Definition of Mechanical Properties: Strength, Stiffness, Ductility, Impact strength, Hardness, Toughness.<br>Fatigue strength, creep strength<br>Definition of Thermal Properties: Specific heat, thermal expansion, melting point, thermal conductivity.<br>Electrical Properties: Electrical conductivity, resistivity, semi-conductor, Dielectric strength, thermoelectricity.<br>Magnetic properties: Magnetic permeability, magnetic hysteresis, Curie temperature, Magnetostriction effect.<br>Criteria of selection of Materials:<br>Property, Cost, Manufacturing process, availability, legal factor, safety factor. | 14 |
| II | **STUDY ABOUT CORROSION, AND CORROSION RESISTANCE MATERIALS**<br><br>Corrosion, Important types of Corrosion (Short brief only)<br>Intergranular corrosion, galvanic corrosion, cathodic polarization, Formation of rust.<br>Prevention of Corrosion: Galvanization, Sacrificial anode, protective coatings, chromium coating, hot dipping-<br>methods of preventing corrosion.<br>Alloys used in Petroleum Industries (Short notes only)<br>Corrosion resistant alloys:<br>Chromium steel having low carbon<br>Chromium steel having high carbon<br>Monel<br>Hastelloy<br>Chromium coated steel<br>Martensitic stainless steel<br>Ferritic stainless steel | 14 |

| | | |
|---|---|---|
| | Austenetic stainless steel | |
| **III** | **HIGH TEMPERATURE AND LOW TEMPERATURE MATERIALS. SUPER ALLOYS**<br><br>HIGH TEMPERATURE APPLICATIONS:<br>High temperature situations (Examples)<br>Creep (Brief description)<br>Effect of high temperature on mechanical properties of materials.<br>Hot hardness, scale resistance<br>Heat resistance materials:<br>(i). Iron base alloys (Nickel - Chromium - Iron Alloys)<br>(ii). Nickel base alloys (Nickel - Chromium Alloys)<br>(iii). Cobalt base alloy (Stellite)<br>(iv). Metal ceramics (brief only)<br>SUPER ALLOYS: (Brief only)<br>18/8 stainless steel - Sensitization, stabilisation.<br>Inconel alloy<br>LOW TEMPERATURE APPLICATIONS:<br>Effect of low temperature on mechanical properties. (Allotropy change, BCC - Embrittlement, conventional properties)<br>Low temperature situations<br>3 alloys used in low temperature (Stainless steels) | **14** |

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|---|---|---|
| IV | **WEAR RESISTANCE MATERIALS, FRICTION AND IMPACT RESISTANCE MATERIALS**<br><br>Wear ,Wear resistant materials, White Cast iron, Had Field's Steel, Stellite<br>IMPACT RESISTANT MATERIAL;<br>Impact strength, impact transition temperature, effect of grain size, effect of alloying Elements (Nickel, Carbon, Silicon, Aluminium) effect of heat treatment.<br>FRICTION MATERIALS:<br>Characteristics of friction materials<br>The materials required for manufacture of brakes and clutches (Wet and Dry)<br>BEARING MATERIALS:<br>Characteristics of bearing metals, applications.<br>CLASSIFICATION: Lead or tin based (White metal, Babbits), Cadmium based, Aluminium based, Silver based, Copper based (Gun metal, Bronze), Sintered bearing material, Non-metallic bearing materials (Nylon * Teflon) | **13** |
| V | **ELECTRICAL, MAGNETIC MATERIALS, MATERIALS FOR NUCLEAR ENGINEERING**<br><br>MATERIALS FOR TOOL APPLICATIONS:<br>Characteristics of tool material<br>CLASSIFICATION:<br>Carbon steels<br>Tool Steels (High Speed Steel) (W-HSS)<br>Cast Non-ferrous materials (Stellite)<br>Cemented carbides<br>Ceramic tools (Aluminium Oxide)<br>Diamond tools<br><br>MATERIALS FOR ELECTRICAL APPLICATIONS:<br>Low Resistivity metals: (Aluminium, Copper)<br>Electrical applications of copper<br>Electrical applications of Aluminium<br>Aluminium conductor steel reinforced (ACSR conductor)<br>High Resistivity Metals: (Tungsten and Nichrome)<br>Electrical applications of tungsten and Nichrome and platinum.<br>Super conductivity, applications<br>Semi conductor (Definition) | **13** |

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|---|---|---|
| | MATERIALS FOR NUCLEAR ENGG APPLICATIONS<br>(Brief Introduction only)<br>List of metals used in Nuclear Reactors.<br>Classification of Nuclear Reactors<br>(Fuel arrangements)<br>Liquid sodium as coolant metal (Comparison with heavy water) | |

**Text Book:**


1. Physical Metallurgical for Engineers, Clark & Varney, Pub. East West Press Pvt Ltd., New Delhi/Madras. 1962.


**Reference Book:**


1. A.S.M. Metals Hand Book Vol .I
2. Structure and Properties of Alloys III Edition, Brick, Gordon & Philips, Eurasia Pub .House Pvt Ltd., New Delhi. 1989.
3. Structure & Properties of light Alloys, A.M. Korol, KOV Pub. Amerind Publishing Co. Pvt Ltd., New Delhi. 1971.
4. Heat Treatment of Metals, T.V.Rajan, C.P.Sharma & Ashok Sharma, Prentice Hall Of India Pvt.ltd, New Delhi.
5. Metallurgy and Material Science, O.P.Khanna, Dhanpat Rai Pub, Delhi.
6. Powder Metallurgy, A.K. Sinha, Dhanpat Rai & Sons
7. Aero Space Materials Vol.1,2 & 3, Balram Guptha, S.Chand & co, New Delhi.

DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN METALLURGY

III YEAR

M SCHEME

VI SEMESTER

2015 -2016 onwards



# 32682 – MATERIALS TECHNOLOGY

CURRICULUM DEVELOPMENT CENTRE

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**

**DIPLOMA IN METALLURGY**
**M-SCHEME**
**(To be implemented to the student admitted from the Year 2015-2016 on wards)**

Course Name : DIPLOMA IN METALLURGY
Course Code : 1026
Subject Code : **3**2682
Semester : VI Semester
Subject Title : **MATERIALS TECHNOLOGY**

**TEACHING AND SCHEME OF EXAMINATION:**

No of weeks per semester: 15 weeks

| Subject Title | Instructions | | Examination | | | |
|---|---|---|---|---|---|---|
| | Hours /Week | Hours /Semester | Marks | | | Duration |
| | | | Internal Assessment | Board Examination | Total | |
| Materials Technology | 5 Hrs | 15 X 5 = 75 Hrs | 25 | 75 | 100 | 3 Hrs |



**Topics and Allocation of Hours:**

| Unit No | Topic | Time(Hrs) |
|---|---|---|
| I | PHASE TRANSFORMATION | 14 |
| II | STEEL & ALLOY STEELS | 14 |
| III | STAINLESS STEELS AND CAST IRONS | 14 |
| IV | NON-FERROUS ALLOYS – COPPER ALLOYS, ALUMINIUM ALLOYS, TITANIUM ALLOYS, MAGNESIUM ALLOYS & NICKEL ALLOYS | 13 |
| V | SPECIAL MATERIALS | 13 |
| | Revision and Test | 7 |
| TOTAL | | 75 |

**RATIONALE:**

The ever expanding Science, Engineering and Technology need materials of varied nature with enhanced properties and at low cost. High temperature applications, low temperature applications, Sub-zero applications like Pressure vessels, Boilers, Aerospace applications, Marine & Submarine applications and Automotive sectors are in need of different materials with widely different combination of properties.

Also new developments in materials like Metallic glasses, Nano materials, Inter-metallics, Super-alloys, Advanced structural ceramics and Composites, Shape memory alloys etc. are to be familiar to the students. This subject provides an insight view about the latest materials, their properties and applications in various fields.

**OBJECTIVES:**

At the end of the study of VI Semester the student will be able to

- To learn about the behaviour of materials under diffusion, nucleation & growth
- To provide knowledge about types, properties & applications of various types of steels, alloy steels & Stainless steels
- To impart knowledge about various types of non-ferrous alloys , their properties and applications
- To give introduction about latest materials, behaviours of engineering materials in diversified fields.

## 32682. MATERIALS TECHNOLOGY

DETAILED SYLLABUS

Contents: Theory

| Unit | Name of the Topic | Hours |
|---|---|---|
| I | **PHASE TRANSFORMATION**<br>Nucleation and crystal growth during solidification – Diffusion laws and kinetics- Important features of pearlitic, bainitic and martensitic transformations – Significance of TTT and CCT diagrams. Strengthening mechanisms: Introduction - Solid solution strengthening, elementary discussion of cold working & grain size strengthening. Precipitation hardening - Ageing (Natural & artificial) - Dispersion strengthening. Recovery recrystallization and grain growth. | 14 |
| II | **STEELS & ALLOY STEELS**<br>Introduction to specifications Indian standards & AISI only– plain carbon steels – low alloy and Q and T steels, dual phase steels – Ultra high strength steels – maraging steels – HSLA steels – steels for magnetic and electrical applications-processing, properties & applications. | 14 |
| III | **STAINLESS STEELS AND CAST IRONS**<br>Stainless steels – phase diagrams – effects of chromium and nickel – ferritic and Austenitic, martensitic, duplex and precipitation hardened stainless steels. Types of Cast Irons- white iron, malleable iron, S.G. Iron alloy cast irons – physical metallurgy, composition of cast irons, properties and applications. Heat treatments of cast irons. | 14 |

| | | |
|---|---|---|
| **IV** | **NON-FERROUS ALLOYS**<br>Brasses, bronzes, Cu-Be alloys, Cu-Ni alloys – High Strength Al Alloys, Ti alloys, Ni alloys and Mg alloys - Physical metallurgy composition, properties and applications. | **13** |
| **V** | **SPECIAL MATERIALS**<br>Composite materials, metallic glasses, Intermetallics, super alloys, Advanced structural ceramics – WC, Tic, TaC, $Al_20_3$, SiC, $Si_3N_4$, CBN and Diamond-properties, processing and applications. Shape memory alloys, polymeric materials, quasi crystals and Nano crystalline materials. | **13** |

**References:**


1. The Physical Metallurgy of Steels, Leslie. W.C, McGraw Hill. 1983.
2. Engineering Materials and their Applications
   Flinn. R.A. and Trojan. P.K. 4th Edition, Jaico, 1999.
3. Solid State Phase Transformations Raghavan. V,
   Prentice Hall of India, New Delhi. 1993
4. Light Alloys Metallurgy of Light Metals, 3rd edition, Polmear I.,.
   Arnold Publishers. 1995.
5. The Science and Engineering of Materials, Askeland. D.R,
   PWT Kent Publishing Company, Boston, 1989
6. Physical Metallurgy and Design of Steels, Pickering F.B,
   Applied Science Publishers Limited. London. 1978.
7. Physical Metallurgy – Principles and Practice, Raghavan V,
   Prentice Hall of India. 1993.
8. Structure and Properties of Alloys, Brick Gardon Philips, McGraw Hill. 1976.
9. A.S.M. Metals Hand book. 10th edition. Volume 2. 1995.

DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN METALLURGY

III YEAR

M SCHEME

VI SEMESTER

2015 -2016 onwards



# 32664 – NON DESTRUCTIVE TESTING PRACTICAL

CURRICULUM DEVELOPMENT CENTRE

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**

**DIPLOMA IN METALLURGY**
**M-SCHEME**
**(To be implemented to the student admitted from the Year 2015-2016 on wards)**

| | | |
|---|---|---|
| Course Name | **:** | DIPLOMA IN METALLURGY |
| Course Code | : | 1026 |
| Subject Code | **:** | **3**2664 |
| Semester | **:** | VI Semester |
| Subject Title | **:** | **NON DESTRUCTIVE TESTING PRACTICAL** |

**TEACHING AND SCHEME OF EXAMINATION:**

No of weeks per semester: 15 weeks

| Subject Title | Instructions | | Examination | | | |
|---|---|---|---|---|---|---|
| | Hours /Week | Hours /Semester | Marks | | | Duration |
| | | | Internal Assessment | Board Examination | Total | |
| Non Destructive Testing Practical | 4 Hrs | 15 X 4 = 60 Hrs | 25 | 75 | 100 | 3 Hrs |



**RATIONALE:**

Modern testing methods should be fast, accurate and highly reliable and which helps in predicting the soundness of parts made by various manufacturing processes. By doing this practical the students will be given the opportunities and increased level of confidence in handling various new advanced and sophisticated instruments for ensuring the quality of the product/part manufactured. New techniques followed by the industries are incorporated to help better understanding the concepts, procedural steps and accurate prediction of the results in locating the defects.

**GUIDELINES:**

- All the experiments given in the list of experiments should be completed and given for the end semester practical examination.
- In order to develop best skills in handling Instruments/Equipment and taking readings in the practical classes, every two students should be provided with a separate experimental setup for doing experiments in the laboratory.

- The external examiners are requested to ensure that a single experimental question should not be given to more than four students while admitting a batch of 30 students during Board Examinations.

**ALLOCATION OF MARKS**

| | |
|---|---|
| Procedure | 20 marks |
| Equipment Handling | 20 marks |
| Observation (including taking readings) | 20 marks |
| Result | 10 marks |
| Viva Voce | 05 marks |
| Total | 75 Marks |

**COMPLETE LIST OF EXPERIMENTS IN DETAIL**



1. Visual Inspection Test on Casting
2. Visual Inspection Test on Weldments
3. Microscopic inspection for porosity, Blow holes
4. Liquid/ Dye Penetrant Test
5. Fluorescent Penetrant Test (ZYGLO)
6. Magnetic Particle Inspection
7. Calibration of Eddy Current Sorter
8. Eddy Current Sorting
9. Calibration of Ultrasonic Flaw Detector
10. Finding thickness of specimen using Ultrasonic Flaw Detector
11. Ultrasonic Flaw Detection

## LIST OF EQUIPMENTS

## AND THE QUANTITY REQUIRED FOR A BATCH OF 30 STUDENTS

| | | |
|---|---|---|
| 1. | Magnetic Particle Tester kit | 1 |
| 2. | Eddy Current Sorter | 1 |
| 3. | Ultrasonic Flaw Detector | 1 |
| 4. | Cleaner spray | 1 ltr |
| 5. | Liquid Dye penetrant spray | 1 ltr |
| 6. | Developer spray | 1 ltr |
| 7. | Fluorescent Dye Penetrant spray | 1 ltr |
| 8. | Ultrasonic Lamp (Black Light) | 1 |
| 9. | Ferro Magnetic Material Powder | 250gms |
| 10. | Standard Sample for Eddy Current Tester | 1 |
| 11. | Standard Sample for Ultrasonic Tester | 1 |
| 12. | Standard Sample for Fatigue Tester | 1 |
| 13. | Oil | 1 ltr. |
| 14. | Single Point Ultrasonic Probe | 1 |

DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN METALLURGY

III YEAR

M SCHEME

VI SEMESTER



2015 -2016 onwards

# 32683 – METAL TESTING PRACTICAL

CURRICULUM DEVELOPMENT CENTRE

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**

**DIPLOMA IN METALLURGY**
**M-SCHEME**
**ELECTIVE PRACTICAL**

**(To be implemented to the student admitted from the Year 2015-2016 on wards)**

Course Name : DIPLOMA IN METALLURGY
Course Code : 1026
Subject Code : **3**2683
Semester : VI Semester
Subject Title : **METAL TESTING PRACTICAL**

**TEACHING AND SCHEME OF EXAMINATION:**

No of weeks per semester: 15 weeks

| Subject Title | Instructions | | Examination | | | |
|---|---|---|---|---|---|---|
| | Hours /Week | Hours /Semester | Marks | | | Duration |
| | | | Internal Assessment | Board Examination | Total | |
| Metal Testing Practical | 4 Hrs | 15 X 4 = 60 Hrs | 25 | 75 | 100 | 3 Hrs |



**RATIONALE:**

From industrial view point, the students are expected to operate various testing equipments and instruments and to evaluate components properties in a quantitative level by destructive way of testing. By doing this practical the student's level of self confidence and his independency will rise.

**GUIDELINES:**

- All the experiments given in the list of experiments should be completed and given for the end semester practical examination.
- In order to develop best skills in handling Instruments/Equipment and taking readings in the practical classes, every two students should be provided with a separate experimental setup for doing experiments in the laboratory.

- The external examiners are requested to ensure that a single experimental question should not be given to more than four students while admitting a batch of 30 students during Board Examinations.

## ALLOCATION OF MARKS

| | |
|---|---|
| Procedure | 10 marks |
| Observation and Tabulation | 20 marks |
| Formula with explanation | 10 marks |
| Calculation | 20 marks |
| Result | 10 marks |
| Viva Voce | 05 marks |
| Total | 75 Marks |



## COMPLETE LIST OF EXPERIMENTS IN DETAIL

1. Tensile test on steel
2. Rockwell Hardness test on Ferrous samples
3. Rockwell Hardness test on Non - Ferrous samples
4. Brinell Hardness test on Ferrous samples
5. Brinell Hardness test on Non - Ferrous samples
6. Poldi Hardness test
7. Izod Impact test
8. Charpy Impact test
9. Cupping test
10. Fatigue testing
11. Deflection test on beams
12. Torsion test on beams

## LIST OF EQUIPMENTS

## AND THE QUANTITY REQUIRED FOR A BATCH OF 30 STUDENTS

| | | |
|---|---|---|
| 1. | Universal Testing Machine | 1 |
| 2. | Brinell Hardness tester | 1 |
| 3. | Rockwell Hardness tester | 1 |
| 4. | Poldi Hardness tester | 1 |
| 5. | Izod Impact tester | 1 |
| 6. | Charpy Impact tester | 1 |
| 7. | Erickson sheet metal tester | 1 |
| 8. | Fatigue testing Machine | 1 |
| 9. | Specimens of 6mm dia. and 600mm length | 30 |
| 10. | M S plate of 100mmx100mm and 0.16mm thickness | 30 |
| 11. | V Notch Standard Specimens | 30+30 |

DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN METALLURGY

III YEAR

M SCHEME

VI SEMESTER



2015 -2016 onwards

# 32684 – CORROSION AND POWDER METALLURGY PRACTICAL

CURRICULUM DEVELOPMENT CENTRE

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**

**DIPLOMA IN METALLURGY**
**M-SCHEME**
**(To be implemented to the student admitted from the Year 2015-2016 on wards)**

| | | |
|---|---|---|
| Course Name | **:** | DIPLOMA IN METALLURGY |
| Course Code | : | 1026 |
| Subject Code | **:** | **3**2684 |
| Semester | **:** | VI Semester |
| Subject Title | **:** | **CORROSION AND POWDER METALLURGY PRACTICAL** |

**TEACHING AND SCHEME OF EXAMINATION:**

No of weeks per semester: 15 weeks

| Subject Title | Instructions | | Examination | | | |
|---|---|---|---|---|---|---|
| | Hours /Week | Hours /Semester | Marks | | | Duration |
| | | | Internal Assessment | Board Examination | Total | |
| Corrosion and Powder Metallurgy Practical | 4 Hrs | 15 X 4 = 60 Hrs | 25 | 75 | 100 | 3 Hrs |



**RATIONALE:**

In practical way the rate of corrosion can be predicted and helps the students in their feature career in adapting the techniques for minimizing the corrosion rate and to combat it. In their higher studies and during research work, the student can able to design and fabricate or at least to assemble his own testing instruments to evaluate the material formulated.

The first step to nano technology begins with the study of powder metallurgy. The experiments designed here will help the students to test and evaluate the powder manufactured by their own processing routine methods.

**GUIDELINES:**

- All the experiments given in the list of experiments should be completed and given for the end semester practical examination.
- In order to develop best skills in handling Instruments/Equipment and taking readings in the practical classes, every two students should be provided with a separate experimental setup for doing experiments in the laboratory.

- The external examiners are requested to ensure that a single experimental question should not be given to more than four students while admitting a batch of 30 students during Board Examinations.

## ALLOCATION OF MARKS

| | |
|---|---|
| Procedure | 20 marks |
| Observation (including taking readings) | 20 marks |
| Tabulation and Calculation | 20 marks |
| Result | 10 marks |
| Viva Voce | 05 marks |
| Total | 75 Marks |



## COMPLETE LIST OF EXPERIMENTS IN DETAIL

1. Estimation of corrosion rate of a metal by weight loss method.
2. Estimation of the effect of an inhibitor on the corrosion rate by weight loss method
3. Salt spray test (ASTM B 117)
4. Huey Test for stainless steels (ASTM A262)
5. Streicher test for stainless steels (ASTM A262)
6. Particle size determination using Sieve method
7. Particle Shape Determination by microscopic method
8. Determination of Apparent Density of Powders
9. Determination of Tap Density of Powders
10. Measurement of Flow Rate of Powders
11. Determination of Compactibility of Powders
12. Determination of Compressibility of Powders.

DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN METALLURGY

III YEAR

M SCHEME

VI SEMESTER

2015 -2016 onwards



# 32666 – WELDING PRACTICAL

CURRICULUM DEVELOPMENT CENTRE

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**

**DIPLOMA IN METALLURGY**
**M-SCHEME**
**(To be implemented to the student admitted from the Year 2015-2016 on wards)**

| | | |
|---|---|---|
| Course Name | **:** | DIPLOMA IN METALLURGY |
| Course Code | : | 1026 |
| Subject Code | **:** | **3**2666 |
| Semester | **:** | VI Semester |
| Subject Title | **:** | **WELDING PRACTICAL** |

**TEACHING AND SCHEME OF EXAMINATION:**

No of weeks per semester: 15 weeks

| Subject Title | Instructions | | Examination | | | |
|---|---|---|---|---|---|---|
| | Hours /Week | Hours /Semester | Marks | | | Duration |
| | | | Internal Assessment | Board Examination | Total | |
| Welding Practical | 6 Hrs | 15 x 6 = 90 Hrs. | 25 | 75 | 100 | 3 Hrs |



**RATIONALE:**

It is very much important to impart basic welding skills to the Diploma Engineer as it is one of the most important manufacturing and salvaging technique.

They should be given training to use both arc welding equipment and Gas welding equipments. The safety precautions should be taught to them. Practice should be given to maintain the welding equipments. Students should know how to strike the arc, maintaining the arc, current selection for particular thickness and how to obtain various types of flames. They should be trained to do welding of different configurations.

**GUIDELINES:**

- All the experiments given in the list of experiments should be completed and given for the end semester practical examination.
- In order to develop best skills in handling Instruments/Equipment and taking readings in the practical classes, every two students should be

provided with a separate experimental setup for doing experiments in the laboratory.

- The external examiners are requested to ensure that a single experimental question should not be given to more than four students while admitting a batch of 30 students during Board Examinations.

## ALLOCATION OF MARKS

| | |
|---|---|
| Procedure | 20 marks |
| Equipment Handling | 20 marks |
| Weld and Bead Finish | 30 marks |
| Viva Voce | 05 marks |
| Total | 75 Marks |



## COMPLETE LIST OF EXPERIMENTS IN DETAIL

Arc welding of

1. Square Butt Joint
2. Single V Joint
3. Double V Joint
4. Edge Joint
5. Lap Joint
6. T joint
7. Corner Joint
8. PAD welding
9. Butt joint in Horizontal position
10. Butt joint in vertical position
11. Oxy-Acetylene Gas cutting by hand
12. Oxy-Acetylene Gas welding Butt joint
13. Oxy-Acetylene Gas welding Lap joint
14. Straight line welding
15. Brazing and Soldering

## LIST OF EQUIPMENTS

## AND THE QUANTITY REQUIRED FOR A BATCH OF 30 STUDENTS

| | | |
|---|---|---|
| 1. | A.C / D.C welding machine | 1+1 |
| 2. | Electrodes with cables | 1 set |
| 3. | Earth Clamp with cables | 1 set |
| 4. | Leather / Asbestos Apron | 15 |
| 5. | Leather / Asbestos hand gloves | 15 |
| 6. | Hand Shield | 15 |
| 7. | Helmet | 15 |
| 8. | Safety goggles | 15 sets |
| 9. | Chipping Hammer | 5 |
| 10. | Wire Brush | 5 |
| 11. | Tong | 15 |
| 12. | Gas welding torch | 2 |
| 13. | Gas welding Nozzle set | 1 set |
| 14. | Nozzle cleaner set | 1 |
| 15. | Oxygen regulator | 1 |
| 16. | Acetylene regulator | 1 |
| 17. | Oxygen & Acetylene Hose in required length | 1 + 1 |
| 18. | Hose clips | 4 |
| 19. | Hose connector | 4 |

| | | |
|---|---|---|
| 20. | Spark lighter | 2 |
| 21. | Goggles | 2 |
| 22. | Water Bucket | 2 |
| 23. | Oxygen Cylinder | 1 |
| 24. | Acetylene Cylinder | 1 |
| 25. | Double end spanner | 1 set |
| 26. | Trolley | 1 |

DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN METALLURGY

III YEAR

M SCHEME

VI SEMESTER



2015 -2016 onwards

**32667– PROJECT WORK ***

CURRICULUM DEVELOPMENT CENTRE

**M-SCHEME**

**(Implements from the Academic year 2015-2016 onwards)**

**Course Name** : DIPLOMA IN METALLURGY

**Course Code** : 1026

**Subject Code** : 32067

**Semester** : VI

**Subject Title** : Project Work

.**TEACHING AND SCHEME OF EXAMINATIONS:**

No. of Weeks per Semester: 15 Weeks

| Subject | Instruction | | Examination | | |
|---|---|---|---|---|---|
| | Hours/ Week | Hours/ Semester | Assessment Marks | | |
| | | | Internal | Board Exam | Total |
| PROJECT WORK | 4 | 60 | 25 | 75 | 100 |



Minimum Marks for Pass is 50 out of which minimum 35 marks should be obtained out of 75 marks in the board Examination alone.

**OBJECTIVES:**

- Implement the theoretical and practical knowledge gained through the curriculum into an application suitable for a real practical working environment preferably in an industrial environment
- Get exposure on industrial environment and its work ethics.
- Understand what entrepreneurship is and how to become an entrepreneur.
- Learn and understand the gap between the technological knowledge acquired through curriculum and the actual industrial need and to compensate it by acquiring additional knowledge as required.
- Carry out cooperative learning through synchronous guided discussions within the class in key dates, asynchronous document sharing and discussions, as well as to prepare collaborative edition of the final project report.
- Understand the facts and importance of environmental management.
- Understand and gain knowledge about disaster management

**INTERNAL ASSESSMENT:**

The internal assessment should be calculated based on the review of the progress of the work done by the student periodically as follows.

| Detail of assessment | Period of assessment | Max. Marks |
|---|---|---|
| First Review | 6th week | 10 |
| Second Review | 12th week | 10 |
| Attendance | Entire semester | 5 |
| **Total** | | **25** |

**EVALUATION FOR BOARD EXAMINATION:**

| Details of Mark allocation | Max Marks |
|---|---|
| Marks for Report Preparation, Demo, Viva-voce | 65 |
| Marks for answers of 4 questions which is to be set by the external examiner from the given question bank consisting of questions in the following two topics Disaster Management and Environmental Management. Out of four questions two questions to appear from each of the above topics i.e. 2 questions x 2 topics = 4 questions<br><br>4 questions x 2 ½ marks = 10 Marks | 10 |
| **Total** | **75** |



## DETAILED SYLLABUS

### ENVIRONMENTAL & DISASTER MANAGEMENT

**1. ENVIRONMENTAL MANAGEMENT**

Introduction – Environmental Ethics – Assessment of Socio Economic Impact – Environmental Audit – Mitigation of adverse impact on Environment – Importance of Pollution Control – Types of Industries and Industrial Pollution.

Solid waste management – Characteristics of Industrial wastes – Methods of Collection, transfer and disposal of solid wastes – Converting waste to energy – Hazardous waste management Treatment technologies.

Waste water management – Characteristics of Industrial effluents – Treatment and disposal methods – Pollution of water sources and effects on human health.

Air pollution management – Sources and effects – Dispersion of air pollutants – Air pollution control methods – Air quality management.

Noise pollution management – Effects of noise on people – Noise control methods.

**2. DISASTER MANAGEMENT**

Introduction – Disasters due to natural calamities such as Earthquake, Rain, Flood, Hurricane, Cyclones etc – Man made Disasters – Crisis due to fires, accidents, strikes etc – Loss of property and life..

Disaster Mitigation measures – Causes for major disasters – Risk Identification – Hazard Zones – Selection of sites for Industries and residential buildings – Minimum distances from Sea – Orientation of Buildings – Stability of Structures – Fire escapes in buildings - Cyclone shelters – Warning systems.

Disaster Management – Preparedness, Response, Recovery – Arrangements to be made in the industries / factories and buildings – Mobilization of Emergency Services - Search and Rescue operations – First Aids – Transportation of affected people – Hospital facilities – Fire fighting arrangements – Communication systems – Restoration of Power supply – Getting assistance of neighbors / Other organizations in Recovery and Rebuilding works – Financial commitments – Compensations to be paid – Insurances – Rehabilitation.



## LIST OF QUESTIONS

**1. ENVIRONMENTRAL MANAGEMENT**

1. What is the responsibility of an Engineer-in-charge of an Industry with respect to Public Health?
2. Define Environmental Ethic.
3. How Industries play their role in polluting the environment?
4. What is the necessity of pollution control? What are all the different organizations you know, which deal with pollution control?
5. List out the different types of pollutions caused by a Chemical / Textile / Leather / Automobile / Cement factory.
6. What is meant by Hazardous waste?
7. Define Industrial waste management.
8. Differentiate between garbage, rubbish, refuse and trash based on their composition and source.

9. Explain briefly how the quantity of solid waste generated in an industry could be reduced.
10. What are the objectives of treatments of solid wastes before disposal?
11. What are the different methods of disposal of solid wastes?
12. Explain how the principle of recycling could be applied in the process of waste minimization.
13. Define the term 'Environmental Waste Audit'.
14. List and discuss the factors pertinent to the selection of landfill site.
15. Explain the purpose of daily cover in a sanitary landfill and state the minimum desirable depth of daily cover.
16. Describe any two methods of converting waste into energy.
17. What actions, a local body such as a municipality could take when the agency appointed for collecting and disposing the solid wastes fails to do the work continuously for number of days?
18. Write a note on Characteristics of hazardous waste.
19. What is the difference between municipal and industrial effluent ?
20. List few of the undesirable parameters / pollutants anticipated in the effluents from oil refinery industry / thermal power plants / textile industries / woolen mills / dye industries / electroplating industries / cement plants / leather industries (any two may be asked)
21. Explain briefly the process of Equalization and Neutralization of waste water of varying characteristics discharged from an Industry.
22. Explain briefly the Physical treatments "Sedimentation" and "Floatation" processes in the waste water treatment.
23. Explain briefly when and how chemical / biological treatments are given to the waste water.
24. List the four common advanced waste water treatment processes and the pollutants they remove.
25. Describe refractory organics and the method used to remove them from the effluent.
26. Explain biological nitrification and de-nitrification.
27. Describe the basic approaches to land treatment of Industrial Effluent.
28. Describe the locations for the ultimate disposal of sludge and the treatment steps needed prior to ultimate disposal.
29. List any five Industries, which act as the major sources for Hazardous Air Pollutants.
30. List out the names of any three hazardous air pollutants and their effects on human health.
31. Explain the influence of moisture, temperature and sunlight on the severity of air pollution effects on materials.
32. Differentiate between acute and chronic health effects from Air pollution.
33. Define the term Acid rain and explain how it occurs.
34. Discuss briefly the causes for global warming and its consequences

35. Suggest suitable Air pollution control devices for a few pollutants and sources.
36. Explain how evaporative emissions and exhaust emissions are commonly controlled.
37. What are the harmful elements present in the automobile smokes? How their presence could be controlled?
38. What is the Advantage of Ozone layer in the atmosphere? State few reasons for its destruction.
39. Explain the mechanism by which hearing damage occurs.
40. List any five effects of noise other than hearing damage.
41. Explain why impulsive noise is more dangerous than steady state noise.
42. Explain briefly the Source – Path – Receiver concept of Noise control.
43. Where silencers or mufflers are used ? Explain how they reduce the noise.
44. Describe two techniques to protect the receiver from hearing loss when design / redress for noise control fail.
45. What are the problems faced by the people residing along the side of a railway track and near to an Airport? What provisions could be made in their houses to reduce the problem?

**2. DISASTER MANAGEMENT**



1. What is meant by Disaster Management? What are the different stages of Disaster management?
2. Differentiate Natural Disasters and Man made Disasters with examples.
3. Describe the necessity of Risk identification and Assessment Surveys while planning a project.
4. What is Disasters recovery and what does it mean to an Industry?
5. What are the factors to be considered while planning the rebuilding works after a major disaster due to flood / cyclone / earthquake? (Any one may be asked)
6. List out the public emergency services available in the state, which could be approached for help during a natural disaster.
7. Specify the role played by an Engineer in the process of Disaster management.
8. What is the cause for Earthquakes? How they are measured? Which parts of India are more vulnerable for frequent earthquakes?
9. What was the cause for the Tsunami 2004 which inflicted heavy loss to life and property along the coast of Tamilnadu ? Specify its epicenter and magnitude.
10. Specify the Earthquake Hazard Zones in which the following towns of Tamilnadu lie: (a) Chennai (b) Nagapattinam (c) Coimbatore (d) Madurai (e) Salem.
11. Which parts of India are experiencing frequent natural calamities such as (a) heavy rain fall (b) huge losses due to floods (c) severe cyclones
12. Define basic wind speed. What will be the peak wind speed in (a) Very high damage risk zone – A, (b) High damage risk zone, (c) Low damage risk zone.

13. Specify the minimum distance from the Sea shore and minimum height above the mean sea level, desirable for the location of buildings.
14. Explain how the topography of the site plays a role in the disasters caused by floods and cyclones.
15. Explain how the shape and orientation of buildings could reduce the damages due to cyclones.
16. What is a cyclone shelter ? When and where it is provided ? What are its requirements ?
17. What Precautionary measures have to be taken by the authorities before opening a dam for discharging the excess water into a canal/river ?
18. What are the causes for fire accidents ? Specify the remedial measures to be taken in buildings to avoid fire accidents.
19. What is a fire escape in multistoried buildings ? What are its requirements ?
20. How the imamates of a multistory building are to be evacuted in the event of a fire/Chemical spill/Toxic Air Situation/ Terrorist attack, (any one may be asked).
21. Describe different fire fighting arrangements to be provided in an Industry.
22. Explain the necessity of disaster warning systems in Industries.
23. Explain how rescue operations have to be carried out in the case of collapse of buildings due to earthquake / blast / Cyclone / flood.
24. What are the necessary steps to be taken to avoid dangerous epidemics after a flood disaster?
25. What relief works that have to be carried out to save the lives of workers when the factory area is suddenly affected by a dangerous gas leak / sudden flooding ?
26. What are the difficulties faced by an Industry when there is a sudden power failure? How such a situation could be managed?
27. What are the difficulties faced by the Management when there is a group clash between the workers? How such a situation could be managed?
28. What will be the problems faced by the management of an Industry when a worker dies because of the failure of a mechanical device due to poor maintenance? How to manage such a situation ?
29. What precautionary measures have to be taken to avoid accidents to labourers in the Industry in a workshop / during handling of dangerous Chemicals / during construction of buildings / during the building maintenance works.
30. Explain the necessity of medical care facilities in an Industry / Project site.
31. Explain the necessity of proper training to the employees of Industries dealing with hazardous products, to act during disasters.
32. What type of disaster is expected in coal mines, cotton mills, Oil refineries, ship yards and gas plants?
33. What is meant by Emergency Plan Rehearsal? What are the advantages of such Rehearsals?
34. What action you will take when your employees could not reach the factory site because of continuous strike by Public Transport workers?

35. What immediate actions you will initiate when the quarters of your factory workers are suddenly flooded due to the breach in a nearly lake / dam, during heavy rain?
36. What steps you will take to avoid a break down when the workers union of your Industry have given a strike notice?
37. List out few possible crisis in an organization caused by its workers? What could be the part of the middle level officials in managing such crisis?
38. What types of warning systems are available to alert the people in the case of predicted disasters, such as floods, cyclone etc.
39. Explain the necessity of Team work in the crisis management in an Industry / Local body.
40. What factors are to be considered while fixing compensation to the workers in the case of severe accidents causing disability / death to them?
41. Explain the legal / financial problems the management has to face if safely measures taken by them are found to be in adequate.
42. Describe the importance of insurance to men and machinery of an Industry dealing with dangerous jobs.
43. What precautions have to be taken while storing explosives in a match/ fire crackers factory?
44. What are the arrangements required for emergency rescue works in the case of Atomic Power Plants?
45. Why residential quarters are not constructed nearer to Atomic Power Plants?



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