



# **SYLLABUS**

## **DIPLOMA IN MECHANICAL ENGINEERING ( REFRIGERATION AND AIR CONDITIONING )**

**Course Code: 1221**

**2015 - 2016**

**M- SCHEME**



**DIRECTORATE OF TECHNICAL EDUCATION  
GOVERNMENT OF TAMILNADU**

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU  
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS**

**M SCHEME**

(Implemented from the Academic year 2015 - 2016 onwards)

***Chairpersons***

**Tmt. S Madumathi, I.A.S.,**  
Director of Technical Education  
Directorate of Technical Education  
Guindy, Chennai – 600 025.

**Dr.K.Sundaramoorthy, M.E, Ph.D.,**  
Additional Director of Technical Education(Polytechnics)  
Directorate of Technical Education  
Guindy, Chennai – 600 025.

***Co-ordinator***

**Dr.M.Isakkimuthu, Ph.D**  
Principal,  
Bharathiyar Centenary Government  
Polytechnic College,  
Ettayapuram-628902

***Convener***

**Dr.S.Vairam, M.E., MBA, Ph.D**  
Principal,  
Government Polytechnic College,  
Coimbatore-641014

**Members**

**Mr.C.Saravanakumar M.Tech.,**  
Lecturer/Mechanical Engineering  
Government Polytechnic College,  
Aranthangi-614 616

**Dr. M Mohanraj Ph.D**  
Professor/ Mechanical Engineering,  
Hindustan College of Engineering &  
Technology,  
Coimbatore – 642 032

**Mr. R Selladurai M.E.,**  
Lecturer(Sen.Gr)/Mechanical  
PSG Polytechnic College,  
Coimbatore – 641 004

**Mr.N Ananda Krishnan B.E.,**  
Managing Director,  
FMAXX Systems, Sivananda Colony,  
Coimbatore-641 012

**Mr .M.Ravichandran B.E**  
Managing Director  
Everest Refrigerations,  
Avarampalayam  
Coimbatore-641025

**Mrs.D.Jamunarani B.E**  
Lecturer/Mechanical Engineering  
Government Polytechnic College  
Coimbatore-641014

## **DIPLOMA COURSES IN ENGINEERING/TECHNOLOGY (SEMESTER SYSTEM)**

**(Implemented from 2015- 2016)**

### **M – SCHEME**

### **REGULATIONS\***

*\* 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 4<sup>th</sup> and/or during 7<sup>th</sup> 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>English & Elements of Economics<br>English & Elements of Commerce | English & Accountancy,<br>English & Elements of Economics,<br>English & Management Principles & Techniques,<br>English & Typewriting | Accountancy & Auditing,<br>Banking,<br>Business Management,<br>Co-operative Management,<br>International Trade,<br>Marketing & Salesmanship,<br>Insurance & Material Management,<br>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 6 <sup>th</sup> week  | 50    | 2 Hrs    |
| Test II  | Unit – III & IV                                                                                                   | End of 12 <sup>th</sup> week | 50    | 2 Hrs    |
| Test III | <b>Model Examination - Compulsory</b><br>Covering all the 5 Units.<br>(Board Examination-question paper-pattern). | End of 15 <sup>th</sup> 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 |

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**Total** 50 marks  
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### 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                                                             | : <b>5 Marks</b>  |
|    | (Award of marks as same as Theory subjects)                            |                   |
| b) | Procedure/ observation and tabulation/<br>Other Practical related Work | : <b>10 Marks</b> |
| c) | Record writing                                                         | : <b>10 Marks</b> |
|    |                                                                        | -----             |
|    | <b>TOTAL</b>                                                           | : <b>25 Marks</b> |
|    |                                                                        | -----             |

- *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  | ... | <b>10 marks</b>                                                  |
| Project Review II | ... | <b>10 marks</b>                                                  |
| Attendance        | ... | <b>05 marks</b> (award of marks same as theory subjects pattern) |
|                   |     | -----                                                            |
| Total             | ... | <b>25 marks</b>                                                  |
|                   |     | -----                                                            |

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                          | ... | <b>30 marks</b> |
| Marks for Report Preparation, Demo | ... | <b>35 marks</b> |
|                                    |     | -----           |
| Total                              |     | <b>65 marks</b> |
|                                    |     | -----           |

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

|                           |                         |                  |
|---------------------------|-------------------------|------------------|
| i) Environment Management | 2 questions X 2 ½ marks | <b>= 5 marks</b> |
| ii) Disaster Management   | 2 questions X 2 ½ marks | <b>= 5 marks</b> |
|                           |                         | -----            |
|                           |                         | <b>10marks</b>   |
|                           |                         | -----            |

\$ - 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             | --        | <b>65 Marks</b> |
| Written Test Mark (from 2 topics for 30 minutes duration) | --        | <b>10 Marks</b> |
| <b>TOTAL</b>                                              | <b>--</b> | <b>75 Marks</b> |

**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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## DIPLOMA IN MECHANICAL (R & A/C) ENGINEERING

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

### L - SCHEME

### M-SCHEME

#### III SEMESTER - W.E.F OCT '16

| Sl. No | Subject Code | Name of subjects                                   | Subject Code | Name of subjects                                                      |
|--------|--------------|----------------------------------------------------|--------------|-----------------------------------------------------------------------|
| 1      | 22031        | Strength of Materials*                             | 32031        | Strength of Materials*                                                |
| 2      | 22032        | Fluid Mechanics and Fluid Power *                  | 32043        | Fluid Mechanics and Fluid Power* [W.E.F. AP ' 17]                     |
| 3      | 22033        | Renewable Energy Sources*                          | 32073        | Renewable Energy Sources and Energy Conservation *[W.E.F OC '17]      |
| 4      | 22034        | Machine Drawing*                                   | 32033        | Machine Drawing*                                                      |
| 5      | 22035        | Mechanical Testing and Quality Control Practical * | 32045        | Strength of Materials and Fluid Mechanics Practical * [W.E.F. AP '17] |
| 6      | 22036        | Fluid Power Practical *                            | 32045        | Strength of Materials and Fluid Mechanics Practical *                 |
| 7      | 20001        | Computer Applications Practical**                  | 32034        | Computer Applications and CAD Practical *                             |

#### IV SEMESTER - W.E.F APR '17

| Sl. No | Subject Code | Name of subjects                                            | Subject Code | Name of subjects                                              |
|--------|--------------|-------------------------------------------------------------|--------------|---------------------------------------------------------------|
| 1      | 22041        | Manufacturing Technology-I*                                 | 32032        | Manufacturing Processes*                                      |
| 2      | 22042        | Thermal Engineering - I*                                    | 32041        | Heat Power Engineering *                                      |
| 3      | 22043        | Electrical Drives & Control*                                | 32044        | Electrical Drives & Control*                                  |
| 4      | 22044        | Computer Aided Machine Drawing Practical*                   | 32034        | Computer Applications and CAD Practical *                     |
| 5      | 22045        | Manufacturing Technology-I Practical*                       | 32036        | Lathe and Drilling Practical *                                |
| 6      | 22046        | Metrology & Measurement and Machine Tool Testing Practical* | 32065        | Machine Tool Testing and Maintenance Practical[W.E.F. AP '18] |
| 7      | 22047        | Electrical Drives & Control Practical*                      | 32047        | Electrical Drives & Control Practical*                        |

\* - Common with Mechanical Engineering

\*\* - Common to all Diploma courses

## V SEMESTER - W.E.F OCT '17

### L - SCHEME

### M-SCHEME

| Sl. No | Subject Code                  | Name of Subjects                                | Subject Code | Name of Subjects                                |
|--------|-------------------------------|-------------------------------------------------|--------------|-------------------------------------------------|
| 1      | 22451                         | Refrigeration                                   | 32451        | Refrigeration                                   |
| 2      | 22452                         | Air Conditioning                                | 32452        | Air Conditioning                                |
| 3      | <b>Elective Theory - I</b>    |                                                 |              |                                                 |
|        | 22471                         | R & A/C Machines                                | 32454        | R & A/C Machines                                |
|        | 22472                         | Cryogenic Engineering                           | 32471        | Cryogenic Engineering                           |
| 4      | 22454                         | Refrigeration and Air Conditioning Applications | 32472        | Refrigeration and Air Conditioning Applications |
| 5      | 22455                         | Refrigeration Practical                         | 32455        | Refrigeration Practical                         |
| 6      | <b>Elective Practical - I</b> |                                                 |              |                                                 |
|        | 22473                         | R & A/C Machines Practical                      | 32474        | R & A/C Machines Practical                      |
|        | 22474                         | Cryogenic Engineering Practical                 | 32473        | Cryogenic Engineering Practical                 |
| 7      | 20002                         | Communication and Life Skills Practical**       | 30002        | Life and Employability Skills Practical **      |

\* - Common with Mechanical Engineering

\*\* - Common to all Diploma courses

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

### L - SCHEME

### M -SCHEME

| Sl. No | Subject Code                   | Name of Subjects                        | Subject Code | Name of Subjects                         |
|--------|--------------------------------|-----------------------------------------|--------------|------------------------------------------|
| 1      | 22061                          | Industrial Engineering and Management * | 32061        | Industrial Engineering and Management *  |
| 2      | 22062                          | Computer Integrated Manufacturing*      | 32062        | Computer Aided Design and Manufacturing* |
| 3      | <b>Elective Theory – II</b>    |                                         |              |                                          |
|        | 22481                          | Design of R & A/C                       | 32481        | Design of R & A/C                        |
|        | 22482                          | R & A/C system Maintenance              | 32482        | R & A/C system Maintenance               |
| 4      | 22464                          | R & A/C Equipment Service Practical     | 32464        | R & A/C Equipment Service Practical      |
| 5      | 22465                          | Air Conditioning Practical              | 32465        | Air Conditioning Practical               |
| 6      | <b>Elective Practical – II</b> |                                         |              |                                          |
|        | 22483                          | Design of R & A/C Practical             | 32483        | Design of R & A/C Practical              |
|        | 22484                          | R & A/C system Maintenance Practical    | 32484        | R & A/C system Maintenance Practical     |
| 7      | 22467                          | Project Work                            | 32467        | Project Work                             |

\* - Common with Mechanical Engineering

\*\* - Common to all Diploma courses

**ANNEXURE – II**  
**M SCHEME**  
**Implemented from 2015 - 2016**

**CURRICULUM OUTLINE**

**1221: DIPLOMA IN MECHANICAL ENGINEERING( R & A/C) ( FULL TIME )**

**THIRD SEMESTER**

| Subject code | Subject                                   | Hours per week |                    |                 |             |
|--------------|-------------------------------------------|----------------|--------------------|-----------------|-------------|
|              |                                           | Theory Hours   | Tutorial / Drawing | Practical Hours | Total Hours |
| 32031        | Strength of Materials *                   | 6              | -                  | -               | 6           |
| 32032        | Manufacturing Processes *                 | 6              | -                  | -               | 6           |
| 32033        | Machine Drawing *                         | -              | 4                  | -               | 4           |
| 32034        | Computer Applications and CAD Practical * | -              | -                  | 6               | 6           |
| 32035        | FOUNDRY AND WELDING PRACTICAL *           | -              | -                  | 4               | 4           |
| 32036        | LATHE and DRILLING PRACTICAL *            | -              | -                  | 4               | 4           |
| 32037        | Metrology and Metallography Practical *   | -              | -                  | 4               | 4           |
| Seminar      |                                           | 1              |                    |                 | 1           |
| Total        |                                           | 13             | 4                  | 18              | 35          |

**FOURTH SEMESTER**

| Subject code | Subject                                               | Hours per week |                    |                 |             |
|--------------|-------------------------------------------------------|----------------|--------------------|-----------------|-------------|
|              |                                                       | Theory Hours   | Tutorial / Drawing | Practical Hours | Total Hours |
| 32041        | Heat Power Engineering *                              | 6              | -                  | -               | 6           |
| 32042        | Special Machines *                                    | 5              | -                  | -               | 5           |
| 32043        | Fluid Mechanics and Fluid Power *                     | 5              | -                  | -               | 5           |
| 32044        | Electrical Drives & Control *                         | 6              | -                  | -               | 6           |
| 32045        | Strength of Materials and Fluid Mechanics Practical * | -              | -                  | 4               | 4           |
| 32046        | Special Machines Practical *                          | -              | -                  | 4               | 4           |
| 32047        | Electrical Drives & Control Practical *               | -              | -                  | 4               | 4           |
| Seminar      |                                                       | 1              |                    |                 | 1           |
| Total        |                                                       | 23             | -                  | 12              | 35          |

\* - Common with Mechanical Engineering

\*\* - Common to all Diploma courses

## FIFTH SEMESTER

| Subject code                | Subject                                         | Hours per week |                    |                 |             |
|-----------------------------|-------------------------------------------------|----------------|--------------------|-----------------|-------------|
|                             |                                                 | Theory Hours   | Tutorial / Drawing | Practical Hours | Total Hours |
| 32451                       | Refrigeration                                   | 6              | -                  | -               | 6           |
| 32452                       | Air Conditioning                                | 6              | -                  | -               | 6           |
| <b>Elective Theory I</b>    |                                                 |                |                    |                 |             |
| 32471                       | Cryogenic Engineering                           | 5              | -                  | -               | 5           |
| 32472                       | Refrigeration and Air Conditioning Applications |                |                    |                 |             |
| 32454                       | R & A/C Machines                                | 5              | -                  | -               | 5           |
| 32455                       | Refrigeration Practical                         | -              | -                  | 4               | 4           |
| <b>Elective Practical I</b> |                                                 |                |                    |                 |             |
| 32473                       | Cryogenic Engineering Practical                 | -              | -                  | 4               | 4           |
| 32474                       | R & A/C Machines Practical                      |                |                    |                 |             |
| 30002                       | Life and Employability Skills Practical **      |                |                    | 4               | 4           |
| Seminar                     |                                                 | 1              |                    |                 | 1           |
| Total                       |                                                 | 23             | -                  | 12              | 35          |

## SIXTH SEMESTER

| Subject code                 | Subject                                   | Hours per week |                    |                 |             |
|------------------------------|-------------------------------------------|----------------|--------------------|-----------------|-------------|
|                              |                                           | Theory Hours   | Tutorial / Drawing | Practical Hours | Total Hours |
| 32061                        | Industrial Engineering and Management*    | 6              | -                  | -               | 6           |
| 32062                        | Computer Aided Design and Manufacturing * | 5              | -                  | -               | 5           |
| <b>Elective Theory II</b>    |                                           |                |                    |                 |             |
| 32481                        | Design of R & A/C                         | 5              | -                  | -               | 5           |
| 32482                        | R & A/C system Maintenance                |                |                    |                 |             |
| 32464                        | R & A/C Equipment Service Practical       | 5              | -                  | -               | 5           |
| 32465                        | Air Conditioning Practical                | -              | -                  | 5               | 5           |
| <b>Elective Practical II</b> |                                           |                |                    |                 |             |
| 32483                        | Design of R & A/C Practical               | -              | -                  | 4               | 4           |
| 32484                        | R & A/C System Maintenance Practical      |                |                    |                 |             |
| 32467                        | Project Work                              |                |                    | 4               | 4           |
| Seminar                      |                                           | 1              |                    |                 | 1           |
| Total                        |                                           | 22             | -                  | 13              | 35          |

\* - Common with Mechanical Engineering ,

\*\* - Common to all Diploma courses

**ANNEXURE – II**  
**M-SCHEME**  
**Implemented from 2015 – 2016**

**SCHEME OF EXAMINATION**  
**1221: DIPLOMA IN MECHANICAL ENGINEERING( R & A/C) ( FULL TIME )**

**THIRD SEMESTER**

| Subject code | Subject                                   | Marks               |            |       | Minimum for Pass | Duration of Exam. Hours |
|--------------|-------------------------------------------|---------------------|------------|-------|------------------|-------------------------|
|              |                                           | Internal Assessment | Board Exam | Total |                  |                         |
| 32031        | Strength of Materials *                   | 25                  | 75         | 100   | 40               | 3                       |
| 32032        | Manufacturing Processes *                 | 25                  | 75         | 100   | 40               | 3                       |
| 32033        | Machine Drawing *                         | 25                  | 75         | 100   | 40               | 3                       |
| 32034        | Computer Applications and CAD Practical * | 25                  | 75         | 100   | 50               | 3                       |
| 32035        | Foundry and Welding Practical *           | 25                  | 75         | 100   | 50               | 3                       |
| 32036        | LATHE and DRILLING PRACTICAL *            | 25                  | 75         | 100   | 50               | 3                       |
| 32037        | Metrology and Metallography practical *   | 25                  | 75         | 100   | 50               | 3                       |

**FOURTH SEMESTER**

| Subject code | Subject                                               | Marks               |             |       | Minimum for Pass | Duration of Exam. Hours |
|--------------|-------------------------------------------------------|---------------------|-------------|-------|------------------|-------------------------|
|              |                                                       | Internal Assessment | Board Exam. | Total |                  |                         |
| 32041        | Heat Power Engineering *                              | 25                  | 75          | 100   | 40               | 3                       |
| 32042        | Special Machines *                                    | 25                  | 75          | 100   | 40               | 3                       |
| 32043        | Fluid Mechanics and Fluid Power *                     | 25                  | 75          | 100   | 40               | 3                       |
| 32044        | Electrical Drives & Control *                         | 25                  | 75          | 100   | 40               | 3                       |
| 32045        | Strength of Materials and Fluid Mechanics Practical * | 25                  | 75          | 100   | 50               | 3                       |
| 32046        | Special Machines Practical *                          | 25                  | 75          | 100   | 50               | 3                       |
| 32047        | Electrical Drives & Control Practical *               | 25                  | 75          | 100   | 50               | 3                       |

## FIFTH SEMESTER

| Subject code                | Subject                                         | Marks               |             |       | Minimum for Pass | Duration of Exam Hours |
|-----------------------------|-------------------------------------------------|---------------------|-------------|-------|------------------|------------------------|
|                             |                                                 | Internal Assessment | Board Exam. | Total |                  |                        |
| 32451                       | Refrigeration                                   | 25                  | 75          | 100   | 40               | 3                      |
| 32452                       | Air Conditioning                                | 25                  | 75          | 100   | 40               | 3                      |
| <b>Elective Theory I</b>    |                                                 |                     |             |       |                  |                        |
| 32471                       | Cryogenic Engineering                           | 25                  | 75          | 100   | 40               | 3                      |
| 32472                       | Refrigeration and Air Conditioning Applications |                     |             |       |                  |                        |
| 32454                       | R & A/C Machines                                | 25                  | 75          | 100   | 40               | 3                      |
| 32455                       | Refrigeration Practical                         | 25                  | 75          | 100   | 50               | 3                      |
| <b>Elective Practical I</b> |                                                 |                     |             |       |                  |                        |
| 32473                       | Cryogenic Engineering Practical                 | 25                  | 75          | 100   | 50               | 3                      |
| 32474                       | R & A/C Machines Practical                      |                     |             |       |                  |                        |
| 30002                       | Life and Employability Skills Practical **      | 25                  | 75          | 100   | 50               | 3                      |

\* - Common with Mechanical Engineering

\*\* - Common to all Diploma courses

## SIXTH SEMESTER

| Subject code                 | Subject                                   | Marks               |             |       | Minimum for Pass | Duration of Exam Hours |
|------------------------------|-------------------------------------------|---------------------|-------------|-------|------------------|------------------------|
|                              |                                           | Internal Assessment | Board Exam. | Total |                  |                        |
| 32061                        | Industrial Engineering & Management*      | 25                  | 75          | 100   | 40               | 3                      |
| 32062                        | Computer Aided Design and Manufacturing * | 25                  | 75          | 100   | 40               | 3                      |
| <b>Elective Theory II</b>    |                                           |                     |             |       |                  |                        |
| 32481                        | Design of R & A/C                         | 25                  | 75          | 100   | 40               | 3                      |
| 32482                        | R & A/C system Maintenance                |                     |             |       |                  |                        |
| 32464                        | R & A/C Equipment Service Practical       | 25                  | 75          | 100   | 50               | 3                      |
| 32465                        | Air Conditioning Practical                | 25                  | 75          | 100   | 50               | 3                      |
| <b>Elective Practical II</b> |                                           |                     |             |       |                  |                        |
| 32483                        | Design of R & A/C Practical               | 25                  | 75          | 100   | 50               | 3                      |
| 32484                        | R & A/C System Maintenance Practical      |                     |             |       |                  |                        |
| 32467                        | Project Work                              | 25                  | 75          | 100   | 50               | 3                      |

\* - Common with Mechanical Engineering

\*\* - Common to all Diploma courses

## Board Examination - Question paper pattern

### **Common for all theory subjects except Machine Drawing and Design of Machine Elements**

**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)

Any tables required should be mentioned in the question paper. Steam table, Design Data Book, Mollier chart, Psychometric Chart etc..



DIRECTORATE OF TECHNICAL EDUCATION  
DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)

M SCHEME  
2015 -2016 onwards

II YEAR  
III SEMESTER

**32031 – STRENGTH OF MATERIALS**

CURRICULUM DEVELOPMENT CENTRE

## M-SCHEME

(Implements from the Academic year 2015-2016 onwards)

**Course Name** : DIPLOMA IN MECHANICAL ENGINEERING(R&AC)  
**Course Code** : 1221  
**Subject Code** : 32031  
**Semester** : III  
**Subject Title** : **STRENGTH OF MATERIALS**

### TEACHING AND SCHEME OF EXAMINATIONS:

No. of Weeks per Semester: 15 Weeks

| Subject               | Instructions |                  | Examination         |                   |       |          |
|-----------------------|--------------|------------------|---------------------|-------------------|-------|----------|
| Strength of Materials | Hours / Week | Hours / Semester | Marks               |                   |       | Duration |
|                       | 6            | 90               | Internal Assessment | Board Examination | Total | 3 Hrs    |
|                       |              |                  | 25                  | 75                | 100   |          |

### Topics and Allocation of Hours:

| Unit | Topics                                                            | Hours     |
|------|-------------------------------------------------------------------|-----------|
| I    | STATICS OF PARTICLE AND FRICTION                                  | 17        |
| II   | MECHANICAL PROPERTIES, SIMPLE STRESSES AND STRAINS                | 17        |
| III  | GEOMETRICAL PROPERTIES OF SECTIONS AND THIN SHELLS                | 17        |
| IV   | SHEAR FORCE AND BENDING MOMENT DIAGRAMS, THEORY OF SIMPLE BENDING | 16        |
| V    | TORSION AND SPRINGS                                               | 16        |
|      | TEST AND REVISION                                                 | 07        |
|      | <b>Total</b>                                                      | <b>90</b> |

## **RATIONALE:**

Day by day, engineering and technology experience tremendous growth. Design plays a major role in developing engineering and technology. Strength of material is backbone for design. The strength of material deals generally with the behaviour of objects, when they are subject to actions of forces. Evaluations derived from these basic fields provide the tools for investigation of mechanical structure.

## **OBJECTIVES**

- Define various Support reaction and equilibrium.
- Calculate the deformation of materials, which are subjected to axial load and shear.
- Determine the moment of Inertia of various sections used in industries.
- Estimate the stresses induced in thin shells.
- Draw the shear force and bending moment diagram of the beam for different loads.

## **STRENGTH OF MATERIALS**

### **DETAILED SYLLABUS**

#### **Contents: Theory**

| <b>Unit</b> | <b>Name of the Topic</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>Hours</b> |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>I</b>    | <b>STATICS OF PARTICLES:</b><br><br>Introduction – Force - effects of a force - system of forces - resultant of force - Principle of transmissibility - parallelogram law of forces - triangular law - resultant of several forces acting on a particle - polygon law - resolution of a force into rectangular components – resultant of a system of forces acting on a particle using rectangular components - equilibrium of particles.<br><br>External and internal forces - moment of a force - Varignon's theorem - moment of a couple - equivalent couples - addition of couples - resolution of a force into a force and a couple - Free body diagram - Necessary and sufficient conditions for the equilibrium of rigid bodies in two dimension - Support reaction - types of support - removal of two dimensional supports - Simple problems only. | <b>17</b>    |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |    |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
|    | <p><b>FRICTION:</b></p> <p>Introduction - Definition - Force of friction - Limiting friction - Static friction - Dynamic friction - Angle of friction - co-efficient of friction - Laws of static and dynamic friction.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |    |
| II | <p><b>DEFORMATION OF METALS</b></p> <p><b>Mechanical properties of materials:</b> Engineering materials – Ferrous and non-ferrous materials - Definition of mechanical properties - Alloying elements-effect of alloying element - Fatigue, fatigue strength, creep – temperature creep – cyclic loading and repeated loading – endurance limit.</p> <p><b>Simple stresses and strains:</b> Definition – Load, stress and strain – Classification of force systems – tensile, compressive and shear force systems – Behaviour of mild steel in tension up to rupture – Stress – Strain diagram – limit of proportionality – elastic limit – yield stress – breaking stress – Ultimate stress – percentage of elongation and percentage reduction in area – Hooke's law – Definition – Young's modulus - working stress, factor of safety, load factor, shear stress and shear strain - modulus of rigidity. Linear strain – Deformation due to tension and compressive force – Simple problems in tension, compression and shear force.</p> <p>Definition – Lateral strain – Poisson's ratio – volumetric strain – bulk modulus – volumetric strain of rectangular and circular bars – problems connecting linear, lateral and volumetric deformation – Elastic constants and their relationship - Problems on elastic constants - Definition – Composite bar – Problem in composite bars subjected to tension and compression – Temperature stresses and strains – Simple problems – Definition – strain energy – proof resilience – modulus of resilience – The expression for strain energy stored in a bar due to Axial load – Instantaneous stresses due to gradual, sudden, impact and shock loads – Problems computing instantaneous stress and deformation in gradual, sudden, impact and shock loadings.</p> | 17 |

|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |    |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| III | <p><b>GEOMETRICAL PROPERTIES OF SECTIONS AND THIN SHELLS</b></p> <p><b>Properties of sections:</b> Definition – center of gravity and centroid - position of centroids of plane geometrical figures such as rectangle, triangle, circle and trapezium-problems to determine the centroid of angle, channel, T and I sections only - Definition-centroidal axis-Axis of symmetry. Moment of Inertia – Statement of parallel axis theorem and perpendicular axis theorem. Moment of Inertia of lamina of rectangle, circle, triangle, I and channel sections-Definition-Polar moment of Inertia-radius of gyration – Problems computing moment of inertia and radius of gyration for angle, T, Channel and I sections.</p> <p><b>Thin Shells:</b> Definition – Thin and thick cylindrical shell – Failure of thin cylindrical shell subjected to internal pressure – Derivation of Hoop and longitudinal stress causes in a thin cylindrical shell subjected to internal pressure – simple problems – change in dimensions of a thin cylindrical shell subjected to internal pressure – problems – Derivation of tensile stress induced in a thin spherical shell subjected to internal pressure – simple problems – change in diameter and volume of a thin spherical shell due to internal pressure – problems.</p> | 17 |
| IV  | <p><b>SF AND BM DIAGRAMS OF BEAMS AND THEORY OF BENDING</b></p> <p>Classification of beams – Definition – shear force and Bending moment – sign conventions for shear force and bending moment – types of loadings – Relationship between load, force and bending moment at a section – shear force diagram and bending moment diagram of cantilever and simply supported beam subjected to point load and uniformly distributed load (udl) – Determination of Maximum bending moment in cantilever beam and simply supported beam when they are subjected to point load and uniformly distributed load.</p> <p>Theory of simple bending – Assumptions – Neutral axis – bending stress distribution – moment of resistance – bending equation – <math>M/I = f/y = E/R</math> – Definition – section modulus - rectangular and circular sections – strength of beam – simple problems involving flexural formula for cantilever and simple supported beam.</p>                                                                                                                                                                                                                                                                                                                                                       | 16 |

|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |    |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| V | <p><b>THEORY OF TORSION AND SPRINGS</b></p> <p>Theory of torsion – Assumptions – torsion equation <math>\frac{T}{J} = \frac{f_s}{R} = \frac{C\theta}{l}</math> – strength of solid and hollow shafts – power transmitted – Definition – Polar modulus – Torsional rigidity – strength and stiffness of shafts – comparison of hollow and solid shafts in weight and strength considerations – Advantages of hollow shafts over solid shafts – Problems.</p> <p>Types of springs – Laminated and coiled springs and applications – Types of coiled springs – Difference between open and closely coiled helical springs – closely coiled helical spring subjected to an axial load – problems to determine shear stress, deflection, stiffness and resilience of closed coiled helical springs</p> | 16 |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|

#### Text Books:

- 1) Strength of Materials, R. S. Khurmi, S.Chand & Co., Ram Nagar, New Delhi.
- 2) Strength of Materials, S. Ramamrutham, 15<sup>th</sup> Edn 2004, DhanpatRai Pub. Co., New Delhi.

#### Reference Books:

- 1) Strength of Materials, R.K. Bansal,, Laxmi Publications Pvt. Ltd., New Delhi, 3<sup>rd</sup> Edition, 2010.
- 2) Strength of materials, S.S.Rattan, Tata Mcgraw hill, New Delhi,2008, ISBN 9780070668959,
- 3) Strength of Materials, B K Sarkar, I Edition, 2003 Tata Mcgraw hill, New Delhi.
- 4) Engineering mechanics, R.K. Bansal, Laxmi Publications Pvt. Ltd., New Delhi, 2<sup>nd</sup> Edition, 2007



DIRECTORATE OF TECHNICAL EDUCATION  
DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)

M SCHEME  
2015 -2016 onwards

II YEAR  
III SEMESTER

**32032 – MANUFACTURING PROCESSES**

CURRICULUM DEVELOPMENT CENTRE

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

**TEACHING AND SCHEME OF EXAMINATIONS:**

| Subject                 | Instructions |                  | Examination         |                   |       |          |
|-------------------------|--------------|------------------|---------------------|-------------------|-------|----------|
| Manufacturing Processes | Hours / Week | Hours / Semester | Marks               |                   |       | Duration |
|                         | 6            | 90               | Internal Assessment | Board Examination | Total | 3 Hrs    |
|                         |              |                  | 25                  | 75                | 100   |          |

| Unit | Topics                          | Hours     |
|------|---------------------------------|-----------|
| I    | FOUNDRY TECHNOLOGY              | 17        |
| II   | WELDING TECHNOLOGY              | 17        |
| III  | FORMING TECHNOLOGY              | 17        |
| IV   | THEORY OF METAL CUTTING & LATHE | 16        |
| V    | DRILLING & METROLOGY            | 16        |
|      | TEST AND REVISION               | 7         |
|      | <b>TOTAL</b>                    | <b>90</b> |

Manufacturing, the major and the most important aspect in industries needs utmost care and attention. Knowledge about various processes and allied areas will be of great use to the personnel involved in production. This will provide the students an opportunity to skill themselves for the industrial scenario.

## Curriculum Development Centre, DOTE.

- Acquire Knowledge about types of pattern, casting, and moulding.
- Describe the various casting processes.
- Knowledge about various welding process and its working principle.
- Appreciate the safety practices used in welding.
- Acquire knowledge about various forming technologies.
- Knowledge about the lathe and its working parts.
- Describe the functioning of semi-automatic lathes.
- Study about the drilling process.
- Study about metrology and measuring instruments.

## MANUFACTURING PROCESSES

### DETAILED SYLLABUS

#### Contents: Theory

| Unit | Name of the Topic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Hours |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| I    | <b>Foundry Technology</b><br><b>Patterns:</b> Definition – types of pattern – solid piece – split piece - loose piece – match plate - sweep - skeleton – segmental – shell – pattern materials – pattern allowances.<br><b>Moulding:</b> Moulding sand – constituents – types – properties of moulding sand – moulding sand preparation – moulding tools - moulding boxes – types of moulds – green sand mould – dry sand mould – loam mould – methods of moulding – moulding machines – jolting – squeezing – sand slinger construction and working principle.<br><b>Cores:</b> Essential qualities of core – materials – core sand preparation – core binders – core boxes - CO <sub>2</sub> process core making – types of core.<br><b>Metallurgy</b> :- Introduction - Iron-carbon diagram.<br><b>Melting furnaces:</b> Blast furnace – Cupola furnace – crucible furnace – types – pit furnace – coke fired – oil fired – electric furnace – types – direct arc – indirect arc – induction furnace – working principles.<br><b>Casting:</b> Shell mould casting – investment casting – pressure die | 17    |

|            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |           |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|            | casting – hot chamber die casting – cold chamber die casting – gravity die casting – centrifugal casting – continuous casting – defects in casting – causes and remedies.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |           |
| <b>II</b>  | <p><b>Welding Technology</b></p> <p><b>Arc Welding:</b> Definition – arc welding equipment – electrode types – filler and flux materials - arc welding methods – metal arc - Metal Inert gas (MIG) - Tungsten inert gas (TIG) - Submerged arc - Electro slag welding – resistance welding – spot welding – butt welding – seam welding – Plasma arc welding – Thermit welding – Electron beam welding – Laser beam welding – friction welding – ultrasonic welding – Induction welding - working principle – applications – advantages and disadvantages.</p> <p><b>Gas welding:</b> Oxy-acetylene welding – advantages - limitations - gas welding equipment - Three types of flames – welding techniques – filler rods. – Flame cutting – soldering – brazing – difference between soldering and brazing.</p> <p>Types of welded joints – merits and demerits of welded joints – inspection and testing of welded joints – destructive and non-destructive types of tests – magnetic particle test – radiographic and ultrasonic test - defects in welding – causes and remedies.</p> | <b>17</b> |
| <b>III</b> | <p><b>Forming Technology</b></p> <p><b>Forging:</b> Hot working, cold working – advantages of hot working and cold working– hot working operations – rolling, forging, smith forging, drop forging, upset forging, press forging – roll forging.</p> <p><b>Press Working:</b> Types of presses - mechanical and hydraulic presses - press tools and accessories - press working operations - bending operations - angle bending - channel bending – curling – drawing - shearing operations - blanking, piercing, trimming – notching – lancing.</p> <p><b>Powder Metallurgy:</b> Methods of manufacturing metal powders – atomization, reduction and electrolysis deposition – compacting – sintering – sizing – infiltration – mechanical properties of parts made by powder metallurgy – design rules for the power</p>                                                                                                                                                                                                                                                              | <b>17</b> |

|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |           |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|           | metallurgy process.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |
| <b>IV</b> | <p><b>Theory of metal cutting:</b> Introduction – orthogonal cutting – oblique cutting - single point cutting tool – nomenclature – types of chips – chip breakers – cutting tool materials – properties – tool wears – factors affecting tool life – cutting fluids – functions – properties of cutting fluid.</p> <p><b>Centre Lathe:</b> Introduction - specifications – simple sketch – principal parts – head stock – back geared type – all geared type – feed mechanism - tumbler gear mechanism – quick change gear box – apron mechanism – work holding device – three jaw chuck – four jaw chuck – centres - faceplate – mandrel – steady rest – follower rest – machining operations done on lathe - straight turning – step turning - taper turning methods: form tool – tailstock set over method – compound rest method – taper turning attachment – knurling - Thread cutting – Facing – Boring – chamfering –grooving – parting-off – eccentric turning - cutting speed – feed - depth of cut - metal removal rate.</p> <p><b>Semi-Automatic Lathes:</b> Types of semi-automatic lathes – capstan and turret lathes – Geneva indexing mechanism – bar feeding mechanism - difference between turret and capstan – work holding devices – tool holders.</p> | <b>16</b> |
| <b>V</b>  | <p><b>Drilling and Metrology</b></p> <p><b>Drilling Machines:</b> Drills - flat drills - twist drills – nomenclature of twist drill - types of drilling machines - bench type - floor type - radial type - gang drill – multi spindle type -principle of operation in drilling - methods of holding drill bit - drill chucks - socket and sleeve –drilling operation – reaming - counter sinking - counter boring - spot facing – tapping - deep hole drilling.</p> <p><b>Metrology:</b> Definition – need of inspection – precision – accuracy – sensitivity - magnification – repeatability – calibration – comparator – Advantages – requirements – mechanical comparator – optical comparator – electrical comparator – pneumatic comparator – Principles – advantages and</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>16</b> |

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |
|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|  | disadvantages.<br><b>Measuring instruments:</b> Construction and principles only - Steel rule – Callipers: outside calliper – inside calliper – jenny calliper – Combination set – Feeler gauge – Pitch screw gauge – Vernier calliper – Digital calliper – Vernier height gauge – Micrometer – Inside micrometer – Thread micrometer – Slip gauges – requirement – Indian standard – care and use - Sine bar – types – uses – limitations – Working principle of clinometers, autocollimator, angle dekkor. |  |
|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|

### Text Books:

- 1) Elements of workshop Technology Volume I & II – Hajra Chowdry & Bhattacharaya - II<sup>th</sup> Edition - Media Promoters & Publishers Pvt. Ltd., Seewai Building 'B', 20-G, Noshir Bharucha Marg, Mumbai 400 007 – 2007.
- 2) Introduction of basic manufacturing processes and workshop technology – Rajendersingh – New age International (P) Ltd. Publishers, 4835/24, Ansari Road, Daryaganj, New Delhi - 110002

### Reference Books:

- 1) Manufacturing process – Begeman - 5<sup>th</sup> Edition -McGraw Hill, New Delhi 1981.
- 2) Workshop Technology- WAJ Chapman - Volume I, II, & III – Vima Books Pvt. Ltd., 4262/3, Ansari Road, Daryaganj, New Delhi 110 002.
- 3) Workshop Technology – Raghuwanshi - Khanna Publishers. Jain & Gupta,
- 4) Production Technology, Edn. XII, Khanna Publishers, 2-B, North Market, NAI Sarak, New Delhi 110 006 - 2006
- 5) Production Technology - P. C. SHARMA - Edn. X - S.Chand & Co. Ltd., Ram Nagar, New Delhi 110 055 - 2006
- 6) Production Technology – HMT - Edn. 18 - published by Tata McGraw Hill publishing Co. Ltd., 7 West Patel nagar, New Delhi 110 008. – 2001.



DIRECTORATE OF TECHNICAL EDUCATION  
DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)

M SCHEME  
2015 -2016 onwards

II YEAR  
III SEMESTER

**32033 – MACHINE DRAWING**

CURRICULUM DEVELOPMENT CENTRE

## M-SCHEME

(Implements from the Academic year 2015-2016 onwards)

**Course Name** : DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)  
**Course Code** : 1221  
**Subject Code** : 32033  
**Semester** : III  
**Subject Title** : MACHINE DRAWING

### TEACHING AND SCHEME OF EXAMINATIONS:

No. of Weeks per Semester: 15 Weeks

| Subject         | Instructions   |                    | Examination            |                      |       |          |
|-----------------|----------------|--------------------|------------------------|----------------------|-------|----------|
| Machine Drawing | Hours/<br>Week | Hours/<br>Semester | Marks                  |                      |       | Duration |
|                 | 4              | 60                 | Internal<br>Assessment | Board<br>Examination | Total | 3 Hrs    |
|                 |                |                    | 25                     | 75                   | 100   |          |

### Topics and Allocation of Hours:

| Unit | Topics                                     | Hours |
|------|--------------------------------------------|-------|
| I    | Sectional Views                            | 5     |
| II   | Limits, Fits and Tolerances                | 5     |
| III  | Surface Texture                            | 5     |
| IV   | Keys, Screw threads and Threaded fasteners | 5     |
| V    | Assemble drawing                           | 33    |
|      | TEST AND REVISION                          | 7     |
|      | Total                                      | 60    |

### RATIONALE:

Manufacturing of various parts start from the basic drawing of components. The assembly of components is also carried out from the drawing. So drawing is an important subject to be studied by the students to carry and complete the production and assembly process successfully.

### OBJECTIVES:

- Appreciate the need for sectional view and types of sections.
- Draw sectional views using different types of sections.
- Explain the use of threaded fasteners and the types of threads.
- Compare hole basis system with shaft basis system.
- Select different types of fits and tolerance for various types of mating parts.
- Appreciate the importance of fits and tolerance.

## MACHINE DRAWING DETAILED SYLLABUS

### Contents: Theory

| Unit | Name of the Topic                                                                                                                                                                                                                                                                                                                                                                               | Hours |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| I    | <b>SECTIONAL VIEWS</b><br>Review of sectioning – Conventions showing the section – symbolic representation of cutting plane- types of section – full section, half section, offset section, revolved section, broken section, removed section – section lining.                                                                                                                                 | 5     |
| II   | <b>LIMITS, FITS AND TOLERANCES</b><br>Tolerances – Allowances – Unilateral and Bilateral tolerances. Limits – Methods of tolerances – Indication of tolerances on linear dimension of drawings – Geometrical tolerances – application – Fits – Classifications of fits – Selection of fits – examples                                                                                           | 5     |
| III  | <b>SURFACE TEXTURE</b><br>Surface texture – importance – controlled and uncontrolled surfaces – Roughness – Waviness – lay – Machining symbols                                                                                                                                                                                                                                                  | 5     |
| IV   | <b>KEYS, SCREW THREADS AND THREADED FASTENERS</b><br>Types of fasteners – temporary fasteners – keys – classification of keys – Heavy duty keys – light duty keys. Screw thread – Nomenclature – different types of thread profiles – threads in sections – threaded fasteners – bolts – nuts – through bolt – tap bolt, stud bolt – set screw – cap screws – machine screws – foundation bolts | 5     |
| V    | <b>MANUAL DRAWING PRACTICE</b>                                                                                                                                                                                                                                                                                                                                                                  | 33    |

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|  | <p>Detailed drawings of following machine parts are given to students to assemble and draw the Elevations / Sectional elevations / Plan / and Side views with dimensioning and bill of materials</p> <ol style="list-style-type: none"> <li>1. Sleeve &amp; Cotter joint</li> <li>2. Knuckle joint</li> <li>3. Screw Jack</li> <li>4. Foot step bearing</li> <li>5. Plummer Block</li> <li>6. Universal Coupling</li> <li>7. Simple Eccentric</li> <li>8. Machine Vice</li> <li>9. Protected type flanged coupling</li> <li>10. Swivel bearing.</li> </ol> |  |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|

**Books:**

- 1) Machine Drawing, P.S. Gill, Katsan Publishing House, Ludiana
- 2) A Text book of Engineering Drawing, R.B. Gupta, Satya Prakasan, Technical India Publications, New Delhi
- 3) Mechanical Draughtsmanship, G.L. Tamta, Dhanpat Rai & Sons, Delhi
- 4) Geometrical and Machine Drawing, N.D. Bhatt, Cheroter book stalls, Anand, West Railway
- 5) Engineering Drawing, D.N. Ghose, Dhanpat Rai & Sons, Delhi

**BOARD EXAMINATIONS**

**Question Pattern**

**Time: 3 Hrs**

**Max Marks : 75**

**Note: All the questions will be answered in drawing sheet only**

**PART A: (7 x 5 = 35)**

**Theory questions: (1 TO 8)**

Two questions from each unit (I to IV) will be asked.

Answer any seven questions from the given eight questions.

**PART B: 40 Marks (Either A or B.)**

**Answer any one question by selecting either A or B.**

9. A. Assemble and Draw any two views and bill of materials.

(OR)

- B. Assemble and Draw any two views and bill of material



DIRECTORATE OF TECHNICAL EDUCATION  
DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)

M SCHEME  
2015 -2016 onwards

II YEAR  
III SEMESTER

**32034 – COMPUTER APPLICATIONS AND  
CAD PRACTICAL**

CURRICULUM DEVELOPMENT CENTRE

## M-SCHEME

(Implements from the Academic year 2015-2016 onwards)

**Course Name** : DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)  
**Course Code** : 1221  
**Subject Code** : 32034  
**Semester** : III  
**Subject Title** : COMPUTER APPLICATIONS AND CAD PRACTICAL

### TEACHING AND SCHEME OF EXAMINATIONS:

No. of weeks per semester: 15 Weeks

| Subject                                 | Instructions |                  | Examination         |                   |       |          |
|-----------------------------------------|--------------|------------------|---------------------|-------------------|-------|----------|
| Computer Applications and CAD practical | Hours / Week | Hours / Semester | Marks               |                   |       | Duration |
|                                         | 6            | 90               | Internal Assessment | Board Examination | Total | 3 Hrs    |
|                                         |              |                  | 25                  | 75                | 100   |          |

### OBJECTIVES:

On completion of the exercises, the students must be able to

- Use the different facilities available in the word processor
- Analyze the data sheet
- Create and manipulate the database
- Prepare PowerPoint presentation
- Practice on CADD commands in making 2D Drawings.
- Draw assembled drawings using CADD.
- Draw sectional views using different types of sections.

### PART – A: COMPUTER APPLICATIONS (30 Hrs)

**WORD PROCESSING** Introduction – Menus – Tool bar – Create – Edit – Save – Alignment – Font Size – Formatting – Tables – Fill Colors – Page Setup - Preview – Water marking – Header – Footer – Clip art.

## Exercises

1. 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.

2. Create the following table using align, border, merging and other attributes.

| <b><u>DIRECTORATE OF TECHNICAL EDUCATION</u></b> |             |             |               |                  |                     |
|--------------------------------------------------|-------------|-------------|---------------|------------------|---------------------|
| <b>e-governance particulars</b>                  |             |             |               |                  |                     |
| <b>Register Number</b>                           | <b>June</b> | <b>July</b> | <b>August</b> | <b>September</b> | <b>Cumulative %</b> |
| <b>16304501</b>                                  |             |             |               |                  |                     |
| <b>16304502</b>                                  |             |             |               |                  |                     |
| <b>16304503</b>                                  |             |             |               |                  |                     |
| <b>16304504</b>                                  |             |             |               |                  |                     |
| <b>16304505</b>                                  |             |             |               |                  |                     |

## SPREADSHEET

Introduction – Menus – Tool bar – Create – Edit – Save – Formatting cells – Chart wizard – Fill Colors – Creating and using formulas – Sorting – Filtering.

## Exercises

3. 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 colour and lowest donation with red colour. The table should have a heading.

4. Prepare line, bar and pie chart to illustrate the subject wise performance of the class for any one semester.

## **DATABASE**

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

### **Exercises**

5. Prepare a payroll for employee database of an organization with the following details: Employee Id, Employee name, Date of Birth, Department and Designation, Date of appointment, Basic pay, Dearness Allowance, House Rent Allowance and other deductions if any. Perform simple queries for different categories.

6. Design a pay slip for a particular employee from the above database.

## **PRESENTATION**

Introduction – Menus – Tool bar – Create – Edit – Save – Slide transition – Insert image – Hyper link – Slide numbers – View slide show with sound – Photo album – Clip art.

### **Exercises**

7. Make a presentation with atleast 10 slides. Use different customized animation effects on pictures and clip art on any four of the ten slides.

## **PART – B: CAD (60 Hrs)**

### **INTRODUCTION**

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.

### **DRAWING AIDS AND EDITING COMMANDS**

Creating objects (2D) – Using draw commands – Creating text – Drawing with precision – Osnap options – drafting settings – 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.

### **BASIC DIMENSIONING, HATCHING, BLOCKS AND VIEWS**

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.

### **CAD EXERCISES**

Detailed drawings of following machine parts are to be given to students. Draw the assembled views (two views only) and bill of materials.

The elevation / sectional elevation / plan / sectional plan / side view with dimensioning.

1. Sleeve & Cotter joint
2. Screw jack
3. Plummer Block
4. Simple Eccentric
5. Machine Vice
6. Protected type flanged coupling

### **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) AutoCAD with Applications - Sham Tickoo - Tata Mcgraw Hill.

## Board of Examination

**Note:** All the exercises have to be completed. Two exercises will be given for examination by selecting one exercise in each PART.

All the exercises should be given in the question paper and students are allowed to select by a lot.

Record note book should be submitted during examination.

### ALLOCATION OF MARKS

|                    |          |                 |
|--------------------|----------|-----------------|
| <b>PART - A</b>    | <b>:</b> | <b>25 marks</b> |
| Editing / Creation | -        | 10              |
| Formatting         | -        | 10              |
| Printout           | -        | 5               |
| <b>PART - B</b>    | <b>:</b> | <b>45 marks</b> |
| Drafting           | -        | 20              |
| Assembly           | -        | 10              |
| Dimensioning       | -        | 10              |
| Printout           | -        | 5               |
| <b>Viva-voce</b>   | <b>:</b> | <b>05 marks</b> |
| <b>Total</b>       | <b>:</b> | <b>75 marks</b> |

### LIST OF EQUIPMENT

1. Personal computer – 30 Nos.
2. Printer – 1 No.
3. Required Softwares :

Office Package, CAD Package – Sufficient to the strength.



DIRECTORATE OF TECHNICAL EDUCATION  
DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)

M SCHEME  
2015 -2016 onwards

II YEAR  
III SEMESTER

**32035 – FOUNDRY AND WELDING PRACTICAL**

CURRICULUM DEVELOPMENT CENTRE

## M-SCHEME

(Implements from the Academic year 2015-2016 onwards)

**Course Name** : DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)  
**Course Code** : 1221  
**Subject Code** : 32035  
**Semester** : III  
**Subject Title** : FOUNDRY AND WELDING PRACTICAL

### TEACHING AND SCHEME OF EXAMINATIONS:

No. of weeks per semester: 15 Weeks

| Subject                                | Instructions   |                    | Examination            |                      |       |          |
|----------------------------------------|----------------|--------------------|------------------------|----------------------|-------|----------|
| FOUNDRY<br>AND<br>WELDING<br>PRACTICAL | Hours/<br>Week | Hours/<br>Semester | Marks                  |                      |       | Duration |
|                                        | 4              | 60                 | Internal<br>Assessment | Board<br>Examination | Total | 3 Hrs    |
|                                        |                |                    | 25                     | 75                   | 100   |          |

### OBJECTIVES:

- Identify the tools used in foundry.
- Identify the tools and equipment 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.
- Prepare a record of work for all the exercises.

### Foundry Section

1. Introduction of tools and equipment
2. Types of patterns
3. Types of sand
4. Preparation of sand moulds
5. Core sands, preparation of cores

**Exercises:**

Prepare the green sand mould using the following patterns.

**Solid pattern**

1. Stepped pulley

**Split pattern**

2. Bent Pipe with core print
3. T-pipes with core print
4. Tumbles

**Loose Piece Pattern**

5. Dovetail

**Core preparation**

6. Core preparation for Bent pipe / T-pipe

**Welding Section**

1. Introduction of Safety in welding shop
2. Introduction to hand tools and equipment
3. Arc and gas welding equipment
4. Types of joints

**Exercises :**

Make the following welding joint / cutting.

**Arc welding (Raw Material: 25 mm x 6mm MS flat)**

1. Lap joint
2. Butt joint
3. T- joint

**Gas Welding (Raw Material: 25mm x 3mm Ms flat)**

4. Lap joint

**Gas cutting: (GI/MS Sheet - 3mm thickness)**

5. Profile cutting – circular profile

**Spot welding: (GI/MS Sheet)**

6. Lap joint

## **BOARD EXAMINATION**

**Note:** All the exercises in both sections have to be completed. Two exercises will be given for examination by selecting one exercise in each section.

All the exercises should be given in the question paper and students are allowed to select by a lot.

Record note book should be submitted during examination.

### **Detailed allocation**

|                         |                   |
|-------------------------|-------------------|
| <b>Foundry</b>          | <b>: 35 marks</b> |
| Preparation of sand     | - 10              |
| Ramming and vent holes  | - 15              |
| Gate cutting / Finish   | - 10              |
| <b>Welding</b>          | <b>: 35 marks</b> |
| Edge preparation        | - 10              |
| Welding / Cutting       | - 15              |
| Joint strength / Finish | - 10              |
| <b>Viva-voce</b>        | <b>: 05 marks</b> |
| <b>Total</b>            | <b>: 75 marks</b> |

## LIST OF EQUIPMENT

### Welding:

|                                   |   |                                          |
|-----------------------------------|---|------------------------------------------|
| 1. Arc welding booth              | - | 2 No's with welding transformer          |
| 2. Gas welding unit               | - | 1 Set<br>(Oxygen and acetylene cylinder) |
| 3. Flux                           | - | Sufficient quantity                      |
| 4. Electrode                      | - | Sufficient quantity                      |
| 5. Welding rod                    | - | Sufficient quantity                      |
| 6. Welding shield                 | - | 5 Nos.                                   |
| 7. Gas welding goggles            | - | 5 Nos.                                   |
| 8. Leather Gloves 18"             | - | 10 Sets.                                 |
| 9. Chipping hammer                | - | 10 Nos.                                  |
| 10. Spot welding machine          | - | 1 No.                                    |
| 11. Personal protective equipment | - | Sufficient quantity                      |
| 12. Fire safety equipment         | - | Sufficient quantity                      |

### Foundry:

|                    |   |                     |
|--------------------|---|---------------------|
| 1. Moulding board  | - | 15 Nos.             |
| 2. Cope box        | - | 15 Nos.             |
| 3. Drag box        | - | 15 Nos.             |
| 4. Core box        | - | 10 Nos.             |
| 5. Shovel          | - | 5 Nos.              |
| 6. Rammer set      | - | 15 Nos.             |
| 7. Slick           | - | 15 Nos.             |
| 8. Strike-off bar  | - | 15 Nos.             |
| 9. Riddle          | - | 5 Nos.              |
| 10. Trowel         | - | 15 Nos.             |
| 11. Lifter         | - | 15 Nos.             |
| 12. Cleaning Brush | - | 20 Nos.             |
| 13. Vent rod       | - | 15 Nos.             |
| 14. Draw spike     | - | 15 Nos.             |
| 15. Gate cutter    | - | 15 Nos.             |
| 16. Runner & riser | - | 15 Nos. each        |
| 17. Patterns       | - | Sufficient quantity |



DIRECTORATE OF TECHNICAL EDUCATION  
DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)

M SCHEME  
2015 -2016 onwards

II YEAR  
III SEMESTER

**32036 – LATHE AND DRILLING PRACTICAL**

CURRICULUM DEVELOPMENT CENTRE

## M-SCHEME

(Implements from the Academic year 2015-2016 onwards)

**Course Name** : DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)  
**Course Code** : 1221  
**Subject Code** : 32036  
**Semester** : III  
**Subject Title** : LATHE and DRILLING PRACTICAL

### TEACHING AND SCHEME OF EXAMINATIONS:

No. of weeks per semester: 15 Weeks

| Subject                            | Instructions   |                    | Examination            |                      |       |          |
|------------------------------------|----------------|--------------------|------------------------|----------------------|-------|----------|
| LATHE and<br>DRILLING<br>PRACTICAL | Hours/<br>Week | Hours/<br>Semester | Marks                  |                      |       | Duration |
|                                    | 4              | 60                 | Internal<br>Assessment | Board<br>Examination | Total | 3 Hrs    |
|                                    |                |                    | 25                     | 75                   | 100   |          |

### OBJECTIVES:

- Identify the parts of a lathe.
- Identify the work holding devices.
- Set the tools for various operations.
- Operate the lathe and machine a component using lathe.
- Identify the parts of drilling machine.
- Perform the various drilling operations.
- Identify the various tools and its holding devices.
- Identify the work holding devices.
- Prepare the record of work for the exercises.

### Lathe section:

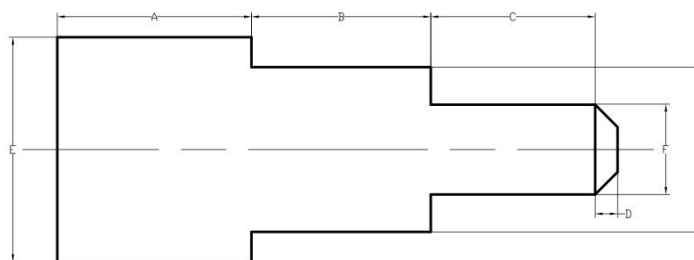
1. Introduction of safety in operating machines.
2. Study of lathe and its parts.
3. Types of tools used in lathe work.
4. Study of work holding devices and tool holding devices.

5. Setting of work and tools.
6. Operation of lathe.
7. Practice on a lathe.
8. Types of measuring instruments and their uses.

### Exercises:

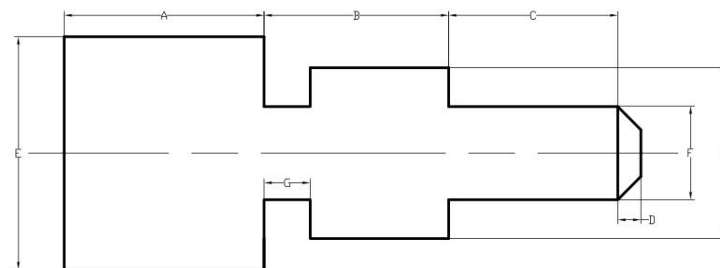
Make the following jobs in the lathe. Raw material  $\square$  32 mm M.S. Rod

1. Facing, Step turning & Chamfering



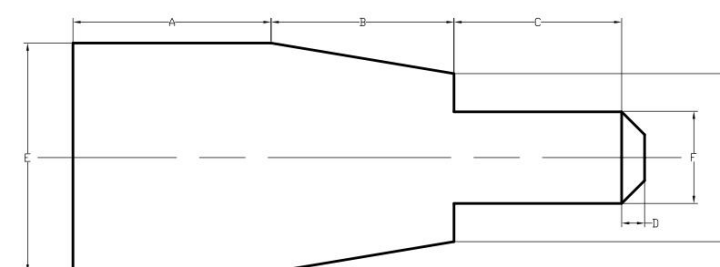
| Dimensions |           |        |          |
|------------|-----------|--------|----------|
| Sl.No      | Part Name | Actual | Obtained |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |

2. Step turning & Groove cutting



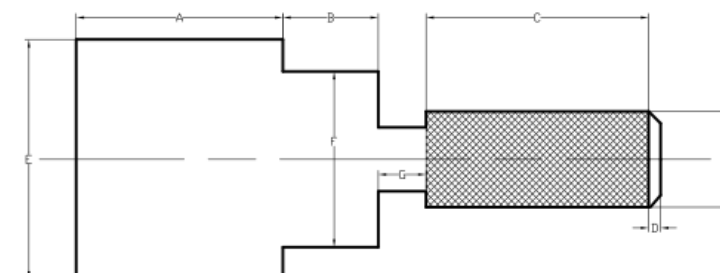
| Dimensions |           |        |          |
|------------|-----------|--------|----------|
| Sl.No      | Part Name | Actual | Obtained |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |

3. Step turning & Taper turning



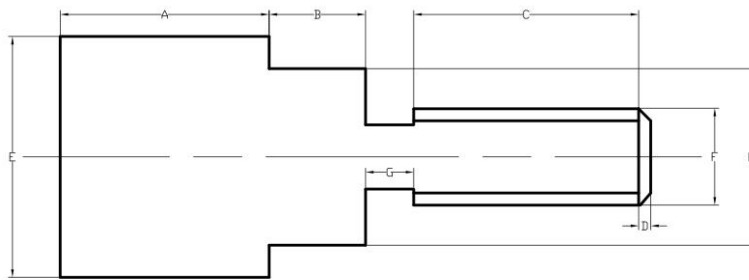
| Dimensions |           |        |          |
|------------|-----------|--------|----------|
| Sl.No      | Part Name | Actual | Obtained |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |

4. Step turning & Knurling



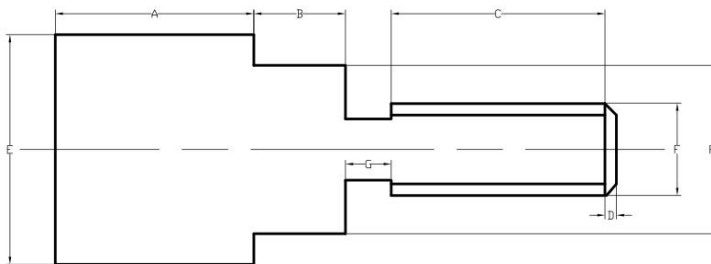
| Dimensions |           |        |          |
|------------|-----------|--------|----------|
| Sl.No      | Part Name | Actual | Obtained |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |

### 5. Step turning & Thread cutting (L.H.)



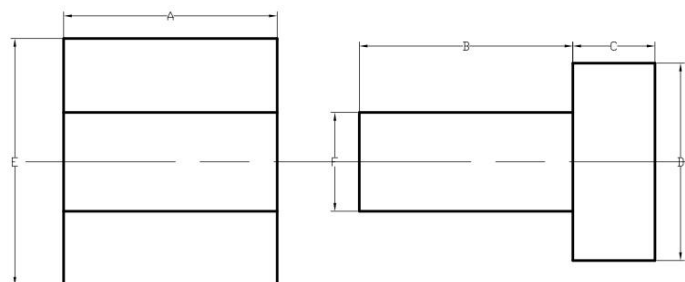
| Dimensions |           |        |          |
|------------|-----------|--------|----------|
| Sl.No      | Part Name | Actual | Obtained |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |

### 6. Step turning & Thread cutting (R.H.)



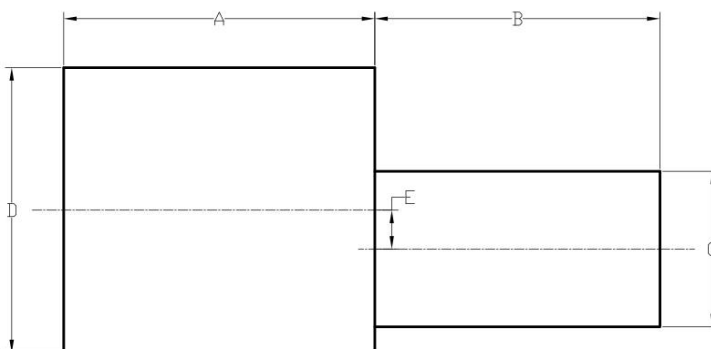
| Dimensions |           |        |          |
|------------|-----------|--------|----------|
| Sl.No      | Part Name | Actual | Obtained |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |

### 7. Bush: Turning & Drilling



| Dimensions |           |        |          |
|------------|-----------|--------|----------|
| Sl.No      | Part Name | Actual | Obtained |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |

### 8. Eccentric turning



| Dimensions |           |        |          |
|------------|-----------|--------|----------|
| Sl.No      | Part Name | Actual | Obtained |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |

### Drilling section:

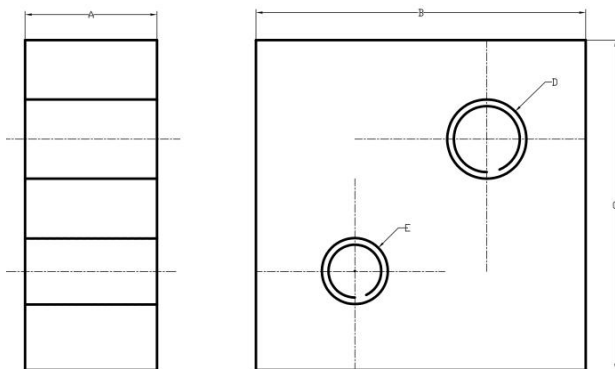
1. Introduction of safety in operating machines.
2. Study of drilling machines and its parts.
3. Study the types of tools used.
4. Study of work holding devices and tool holding devices.
5. Setting of work and tools.
6. Operation and practice.
7. Types of measuring instruments and their uses.

### Exercises:

**Make the following jobs in the drilling machine.**

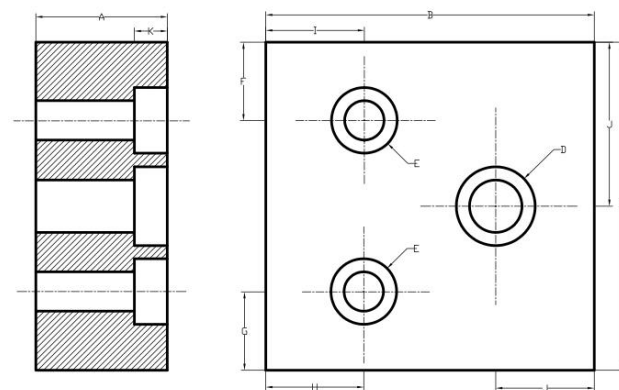
**Raw material 50mm X 50mm X 20 mm thick M.S. Flat**

#### 1. Drilling & Tapping



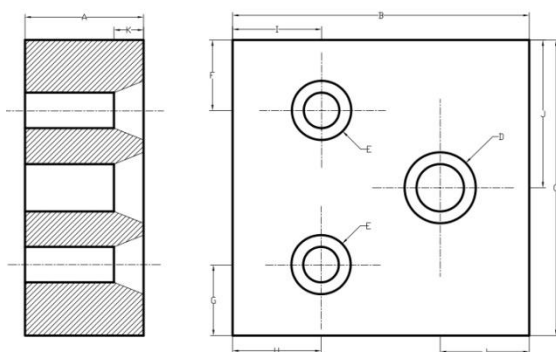
| Dimensions |           |        |          |
|------------|-----------|--------|----------|
| Sl.No      | Part Name | Actual | Obtained |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |

#### 2. Drilling & Counter boring



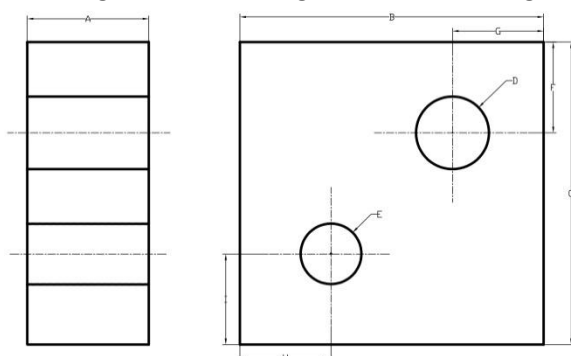
| Dimensions |           |        |          |
|------------|-----------|--------|----------|
| Sl.No      | Part Name | Actual | Obtained |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |

### 3. Drilling & Counter sinking



| Dimensions |           |        |          |
|------------|-----------|--------|----------|
| Sl.No      | Part Name | Actual | Obtained |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |

### 4. Drilling and Reaming – Radial drilling machine



| Dimensions |           |        |          |
|------------|-----------|--------|----------|
| Sl.No      | Part Name | Actual | Obtained |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |

## **BOARD EXAMINATION**

**Note:** All the exercises in both sections have to be completed. Two exercises will be given for examination by selecting one exercise in each section. All the exercises should be given in the question paper and students are allowed to select by a lot.

Record note book should be submitted during examination.

**Lathe : 45 marks (2hours)**

Procedure / Preparation 10

Machining / Dimensions 25

Surface Finishing 10

**Drilling : 25 marks (1 hour)**

Procedure / Marking 10

Dimensions 10

Surface Finishing 5

**Viva-voce : 05 marks**

**Total : 75 marks**

## LIST OF EQUIPMENT

### **Lathe Section**

|                                         |   |                     |
|-----------------------------------------|---|---------------------|
| 1. Lathe (Minimum 4 ½')                 | - | 13 Nos.             |
| 2. All geared lathe                     | - | 2 Nos.              |
| 3. 4 Jaw / 3 Jaw Chucks                 | - | Required Numbers    |
| 4. Chuck key                            | - | Required Numbers    |
| 5. Spanner                              | - | Sufficient quantity |
| 6. Cutting Tools                        | - | Sufficient quantity |
| 7. Pitch gauge                          | - | 5 Nos.              |
| 8. Thread gauge                         | - | 5 Nos.              |
| 9. Vernier Caliper                      | - | 5 Nos.              |
| 10. Snap gauges                         | - | Sufficient quantity |
| 11. Steel Rule (0-150)                  | - | Sufficient quantity |
| 12. Calipers (Inside / Outside / Jenny) | - | Sufficient quantity |
| 13. Dial Gauge with Magnetic Stand      | - | Sufficient quantity |
| 14. Marking Gauge                       | - | Sufficient quantity |
| 15. Safety Glass                        | - | 15 Nos.             |

### **Drilling Section**

|                             |   |                     |
|-----------------------------|---|---------------------|
| 1. Upright drilling machine | - | 2 Nos.              |
| 2. Radial drilling machine  | - | 1 No.               |
| 3. Drill bit & Tap set      | - | Sufficient quantity |
| 4. Reaming bit              | - | Sufficient quantity |
| 5. Counter sinking bit      | - | Sufficient quantity |
| 6. Counter boring bit       | - | Sufficient quantity |
| 7. Plug gauges              | - | Sufficient quantity |
| 8. Vernier Height Gauge     | - | 1 No.               |
| 9. Surface plate            | - | 2 Nos.              |



**DIRECTORATE OF TECHNICAL EDUCATION  
DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)**

**M SCHEME  
2015 -2016 onwards**

**II YEAR  
III SEMESTER**

**32037 – METROLOGY AND METALLOGRAPHY  
PRACTICAL**

**CURRICULUM DEVELOPMENT CENTRE**

## M-SCHEME

(Implements from the Academic year 2015-2016 onwards)

**Course Name** : DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)  
**Course Code** : 1221  
**Subject Code** : 32037  
**Semester** : III  
**Subject Title** : METROLOGY & METALLOGRAPHY PRACTICAL

### TEACHING AND SCHEME OF EXAMINATIONS:

No. of weeks per semester: 15 Weeks

| Subject                                   | Instructions   |                    | Examination            |                      |       |          |
|-------------------------------------------|----------------|--------------------|------------------------|----------------------|-------|----------|
| Metrology &<br>Metallography<br>Practical | Hours/<br>Week | Hours/<br>Semester | Marks                  |                      |       | Duration |
|                                           | 4              | 60                 | Internal<br>Assessment | Board<br>Examination | Total | 3 Hrs    |
|                                           |                |                    | 25                     | 75                   | 100   |          |

### OBJECTIVES:

- Familiarize about measuring techniques of Metrology instruments.
- Select the range of measuring tools.
- Obtain accurate measurements.
- Determine the least count of measuring instruments.
- Study the working principle of Microscope.
- Specimen preparation of ferrous and non-ferrous metals.
- Grinding, polishing and mounting of specimen.
- Non-destructive testing of metals for cracks.
- Crack detection – Visual inspection, Die penetration method
- Prepare the record of work for the exercises.

### METROLOGY SECTION:

- Introduction to linear measurement.
- Introduction to angular measurement.
- Introduction to geometric measurements.

- Study of Least Count of measuring instruments.
- Study of accuracy of instruments and calibration of instruments.
- Study of Linear Measuring Instruments: Vernier Caliper, Micrometer, Inside Micrometer, Vernier Height gauge, Depth Gauge and Slip Gauge.
- Study of Angular Measuring Instruments – Universal Bevel Protractor, Sine Bar.
- Study of Geometric measurement - Gear tooth Vernier, Thread Micrometer.

### **Exercises:**

1. Measure the dimensions of ground MS flat / cylindrical bush using Vernier Caliper compare with Digital / Dial Vernier Caliper.
2. Measure the diameter of a wire using micrometer and compare the result with digital micrometer
3. Measure the thickness of ground MS plates using slip gauges
4. Measure the angle of a V-block / Taper Shank of Drill / Dovetail using universal bevel protractor.
5. Measure the angle of the machined surface using sine bar with slip gauges.
6. Measure the geometrical dimensions of V-Thread using thread Vernier gauge.
7. Measure the geometrical dimensions of spur gear.

### **METALLOGRAPHY SECTION:**

- To study the micro structure of the metals using Metallurgical Microscope.
- Determine the micro structure of the ferrous and nonferrous metals.
- Prepare the specimen to study the microstructure.
- Conduct the liquid penetration test to find the crack.
- Conduct magnetic particle test to find cracks.

**Exercises:**

1. Find the grain structure of the given specimen using the Metallurgical Microscope.
2. Prepare a specimen to examine the micro structure of the Ferrous and Non-ferrous metal.
3. Detect the cracks in the specimen using Visual Inspection and ring test.
4. Detect of cracks in specimen using Die penetration test.
5. Detect the cracks in specimen using Magnetic particle test.

**BOARD EXAMINATION**

**Note:** All the exercises in both sections have to be completed. Two exercises will be given for examination by selecting one exercise in each section. All the exercises should be given in the question paper and students are allowed to select by a lot.

Record note book should be submitted during examination.

**Detailed allocation**

|                              |           |
|------------------------------|-----------|
| <b>Metrology Section</b>     | <b>45</b> |
| Procedure / Least Count      | 15        |
| Reading / Calculation        | 20        |
| Result                       | 10        |
| <b>Matallography Section</b> | <b>25</b> |
| Procedure                    | 10        |
| Preparation and observation  | 10        |
| Result                       | 5         |
| <b>Viva voce</b>             | <b>5</b>  |
| <b>Total</b>                 | <b>75</b> |

### **LIST OF EQUIPMENTS**

|                                                |   |                     |
|------------------------------------------------|---|---------------------|
| 1. Vernier Caliper                             | - | 2 Nos.              |
| 2. Digital Vernier Caliper.                    | - | 2 Nos.              |
| 3. Dial Vernier Caliper.                       | - | 2 Nos.              |
| 4. Micrometer                                  | - | 2 Nos.              |
| 5. Digital Micrometer                          | - | 2 Nos.              |
| 6. Slip gauges                                 | - | 2 Nos.              |
| 7. Universal bevel protractor.                 | - | 2 Nos.              |
| 8. Sine bar                                    | - | 2 Nos.              |
| 9. Thread micrometer                           | - | 2 Nos.              |
| 10. Surface plate                              | - | 2 Nos.              |
| 11. Vernier height gauge                       | - | 1 No.               |
| 12. Metallurgical Microscope.                  | - | 2 Nos.              |
| 13. Die penetration                            | - | 2 Nos.              |
| 14. Magnetic particle test                     | - | 1 No.               |
| 15. Abrasive belt grinder                      | - | 1 No.               |
| 16. Polishing machine                          | - | 1 No.               |
| 17. Mounting machine                           | - | 1 No.               |
| 18. Specimen<br>(Ferrous / Non-ferrous metals) | - | Sufficient quantity |
| 19. Consumable                                 | - | Sufficient quantity |



DIRECTORATE OF TECHNICAL EDUCATION  
DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)

M SCHEME  
2015 -2016 onwards

II YEAR  
IV SEMESTER

**32041 – HEAT POWER ENGINEERING**

CURRICULUM DEVELOPMENT CENTRE

## M-SCHEME

(Implements from the Academic year 2015-2016 onwards)

**Course Name** : DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)  
**Course Code** : 1221  
**Subject Code** : 32041  
**Semester** : IV  
**Subject Title** : HEAT POWER ENGINEERING

### TEACHING AND SCHEME OF EXAMINATIONS:

No. of Weeks per Semester: 15 Weeks

| Subject                | Instructions   |                    | Examination            |                      |       |          |
|------------------------|----------------|--------------------|------------------------|----------------------|-------|----------|
| Heat Power Engineering | Hours/<br>Week | Hours/<br>Semester | Marks                  |                      |       | Duration |
|                        | 6              | 90                 | Internal<br>Assessment | Board<br>Examination | Total | 3 Hrs    |
|                        |                |                    | 25                     | 75                   | 100   |          |

### Topics and Allocation of Hours:

| Unit | Topics                                                                | Hours |
|------|-----------------------------------------------------------------------|-------|
| I    | BASICS OF THERMODYNAMICS AND THERMODYNAMIC PROCESSES OF PERFECT GASES | 17    |
| II   | THERMODYNAMIC AIR CYCLES AND FUELS & COMBUSTION                       | 17    |
| III  | AIR COMPRESSORS AND GAS TURBINES                                      | 17    |
| IV   | FORMATION & PROPERTIES OF STEAM AND STEAM CALORIMETERS                | 16    |
| V    | STEAM BOILERS AND PERFORMANCE OF BOILERS                              | 16    |
|      | TEST AND REVISION                                                     | 7     |
|      | Total                                                                 | 90    |

## RATIONALE:

The knowledge on the concept of Thermodynamics, Thermodynamic Processes, Steady flow energy equation and steam properties and performance of Boilers are vital.

## OBJECTIVES

- Explain a basics of systems, laws of thermodynamics and thermodynamic processes.
- Explain different types of Air Cycles.
- Explain the fuels and combustion.
- Explain a air compressors and gas turbines.
- Explain a formation and properties of steam and steam calorimeters.
- Explain a steam boilers and performance of boilers.

## HEAT POWER ENGINEERING

### DETAILED SYLLABUS

#### Contents: Theory

| Unit | Name of the Topic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Hours |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| I    | <b>BASICS OF THERMODYNAMICS AND THERMODYNAMIC PROCESSES OF PERFECT GASES</b><br><b>Introduction:-</b> Definitions and units of mass, weight, volume, density, specific weight, specific gravity and specific volume – pressure – units of pressure – temperature - absolute temperature – S.T.P and N.T.P conditions – heat - specific heat capacity at constant volume and at constant pressure – work – power – energy – types - law of conservation of energy – thermodynamic system – types – thermodynamic equilibrium - properties of systems – intensive and extensive properties – State of System - process – cycle – point and path functions - zeroth, first and second laws of thermodynamics.<br><b>Perfect gases:</b> - laws of perfect gases – Boyle's, Charle's, Joule's, Regnault's and Avogadro's laws – General Gas Equation - Characteristic gas equation – relation between specific heats and gas constant – Universal gas constant –Change in Internal Energy-enthalpy – change in enthalpy – entropy. | 17    |

|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |    |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
|     | <p><b>Thermodynamic processes:-</b> Constant volume, Constant pressure, Constant temp.(isothermal) ,Isentropic ( reversible adiabatic ) and, Polytropic Processes – p-V and T-s diagrams, work done , change in internal energy , heat transfer , change in enthalpy, change in entropy for above processes – Simple problems – hyperbolic ,Free expansion and throttling processes(Description only) .</p> <p><b>Steady flow system:</b> – control volume – steady flow energy equation – assumptions – Engineering applications.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                    |    |
| II  | <p><b>THERMODYNAMIC AIR CYCLES AND FUELS &amp; COMBUSTION</b></p> <p><b>Air cycles:</b> – air standard efficiency – reversible and irreversible processes – assumptions in deriving air standard efficiency – Carnot cycle – Otto cycle – Diesel cycle - Comparison of ideal and actual p-v diagrams of Otto and Diesel cycles – Simple problems</p> <p><b>Fuels &amp; Combustion:</b></p> <p>Classifications of fuels - merits and demerits – requirements of a good fuel – Octane number – detonation - Pre-ignition – Cetane number – Diesel knock – comparison of detonation and diesel knock - fuel additives – Stages of Combustion – Delay period – Variables affecting delay period – Methods of generating air swirl in diesel engine combustion chambers – Types of combustion chambers – combustion equations – stoichiometric air required for complete combustion of fuels – excess air – products of combustion – analysis of exhaust gases - calorific value of fuels.</p> | 17 |
| III | <p><b>AIR COMPRESSORS AND GAS TURBINES</b></p> <p><b>Air Compressors:-</b> Uses of compressed air – classifications of Air compressor – reciprocating compressor - single stage reciprocating compressor – compression processes – clearance volume and its effects – volumetric efficiency – multi stage compression – merits and demerits – Two stage compressor with imperfect cooling- with perfect inter cooling – rotary compressors – Roots blower - vane blowers – centrifugal and axial flow air compressors – simple problems.</p> <p>Gas turbines – uses - classifications – merits and demerits -</p>                                                                                                                                                                                                                                                                                                                                                                         | 17 |

|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|           | constant pressure combustion gas turbine – gas turbine with intercooler, reheater, regenerator - effects – closed cycle gas turbines - merits and demerits – jet propulsion - turbojet engines – turbo propeller engines – ramjet – Working principle - merits and demerits – Rocket engines – applications of rockets.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |           |
| <b>IV</b> | <p><b>FORMATION &amp; PROPERTIES OF STEAM AND STEAM CALORIMETERS</b></p> <p>Steam - Properties – formation of steam – saturation temperature – enthalpy of water – enthalpy of evaporation – conditions of steam – dryness fraction – enthalpy of wet, dry and superheated steam - advantages of superheated steam – p-v diagram - T-H diagram – T-S diagram - H-S diagram – P-H diagram – critical conditions of water – specific volume of water and steam – density of steam – external work done during evaporation – internal latent heat – internal energy of steam – entropy of water and steam – steam tables - Mollier chart.</p> <p><b>Expansion process of Steam:</b> Constant Volume process – Constant Pressure Process – Constant Temperature process – Hyperbolic Process – Isentropic process – Polytropic process – Throttling process. – Simple problems.</p> <p><b>Steam Calorimeter:</b> Determination of dryness fraction of steam – bucket calorimeter - combined separating and throttling calorimeters.</p> | <b>16</b> |
| <b>V</b>  | <p><b>STEAM BOILERS AND PERFORMANCE OF BOILERS</b></p> <p><b>Steam Boilers:</b> Introduction - Classification of boilers – comparison of fire tube and water tube boilers – high pressure boilers – advantages of high pressure boilers - Lamont and BHEL high pressure boilers – boiler mountings and accessories - function - construction and working – comparison of mountings and accessories – feed water treatment – internal and external treatments - starting boiler from cold condition – safety precautions in boiler operation – causes of Indian boiler act.</p> <p><b>Performance of boilers:</b> Evaporation rate - actual, equivalent and factor of evaporation – boiler efficiency – factors influencing boiler</p>                                                                                                                                                                                                                                                                                               | <b>16</b> |

|  |                                                                                                                                                                                                         |  |
|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|  | efficiency - boiler power – Simple problems – boiler plant - efficiency of economizer and super heater – Simple problems - boiler trial – heat losses in a boiler- heat balance sheet – Simple problems |  |
|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|

**Text Book:**

- 1) Thermal Engg, R.K .Rajput , ,8<sup>th</sup> Edition, Laxmi publications, Pvt Ltd , New Delhi.
- 2) Applied Thermodynamics ,P.K. Nag, ,2<sup>nd</sup> Edition,TATA Mcgraw - Hill Publishing Company,
- 3) New Delhi .
- 4) Thermal Engineering, R.S. Khurmi and J.K. Gupta, 18<sup>th</sup> Edition,S.Chand&Co,NewDelhi

**Reference Books:**

- 1) Thermal Engineering ,P.LBallaney , 24<sup>th</sup> Edition ,Khanna Publishers, New Delhi.
- 2) Thermal Engineering ,B.K. Sarkar , 3<sup>rd</sup> Edition , DhanpatRai& Sons New Delhi .
- 3) Applied Thermodynamics, Domkundwar and .P.Kothandaraman, 2<sup>nd</sup>Edition, Khanna publishers, New Delhi.



DIRECTORATE OF TECHNICAL EDUCATION  
DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)

M SCHEME  
2015 -2016 onwards

II YEAR  
IV SEMESTER

**32042 – SPECIAL MACHINES**

CURRICULUM DEVELOPMENT CENTRE

## M-SCHEME

(Implements from the Academic year 2015-2016 onwards)

**Course Name** : DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)  
**Course Code** : 1221  
**Subject Code** : 32042  
**Semester** : IV  
**Subject Title** : SPECIAL MACHINES

### TEACHING AND SCHEME OF EXAMINATIONS:

No. of weeks per semester: 15 Weeks

| Subject             | Instructions   |                    | Examination            |                      |          |
|---------------------|----------------|--------------------|------------------------|----------------------|----------|
|                     | Hours/<br>Week | Hours/<br>Semester | Marks                  |                      | Duration |
|                     | 5              | 75                 | Internal<br>Assessment | Board<br>Examination | Total    |
| Special<br>Machines |                |                    | 25                     | 75                   | 100      |
|                     |                |                    |                        |                      | 3 Hrs    |

### Topics and Allocation of Hours:

| Unit | Topics                                                          | Hours     |
|------|-----------------------------------------------------------------|-----------|
| I    | Manufacturing of Plastic Components and Composite Manufacturing | 14        |
| II   | Reciprocating Machines and                                      | 14        |
| III  | Milling Machines and Gear                                       | 14        |
| IV   | Abrasive Process and Non-Conventional Machining Processes       | 13        |
| V    | CNC Machine and Its Components                                  | 13        |
|      | TEST AND REVISION                                               | 7         |
|      | <b>Total</b>                                                    | <b>75</b> |

## RATIONALE:

In the process of manufacturing we should possess adequate and through knowledge about the working of conventional as well as non conventional machines. The topics included aim to inculcate in the students the skills of metal cutting, milling, grinding, CNC machines and other machining processes which are very much essential for a technician to at promptly and with precision.

## OBJECTIVES:

- Understand the plastic components and its process.
- Study the manufacturing of Composite materials.
- Study the working of various machine tools: Planer, Shaper and Slotter.
- Study the various work holding devices
- Study various types of milling cutter.
- Study the different types of grinders and grinding wheels.
- Study the broaching operation and their applications.
- Study the milling procedure for spur, helical and bevel gears.
- Study the various types of gear generating processes
- Study the use of non-conventional machining processes.
- Study the CNC machines working principle and its components.

## SPECIAL MACHINES DETAILED SYLLABUS

### Contents: Theory

| Unit | Name of the Topic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Hours |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| I    | <b>MANUFACTURING OF PLASTIC COMPONENTS</b><br><b>Plastic Components:</b> Types of plastics - Engineering plastics – thermosets – composite - structural foam, elastomers - polymer alloys and liquid crystal polymers. Factors Influencing the Selection Of Plastics - Mechanical properties – degradation - wear resistance - frictional properties - special properties –processing – cost<br><b>Processing of Plastics:</b> Extrusion-general features of single screw extrusion -twin screw extruders. Injection moulding types: Plunger type - Reciprocating screw injection - details of injection mould - structural foam injection mould - sandwich moulding - gas injection moulding - | 14    |

|            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |           |
|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|            | <p>injection moulding of thermosetting materials - calendaring and rotational moulding. Design consideration for plastic components.</p> <p><b>Composite manufacturing:</b> Introduction – characteristics of composite manufacturing - constituents – Glass fibers manufacturing process – hand laminating process – autoclave processing – filament winding – pultrusion process – liquid composite process – working principles by schematic diagram only – advantages – disadvantages.</p>                                                                                                                                                                                                                                                                                                                                                                                                                           |           |
| <b>II</b>  | <p><b>RECIPROCATING MACHINES</b></p> <p><b>Planer:</b> Introduction - description of double housing planer – specifications -principles of operation – drives - quick return mechanism - feed mechanism - work holding devices and special fixtures - types of tools - operations.</p> <p><b>Shaper:</b> Introduction – specifications – principles of operations standard shaper – quick return mechanism - crank and slotted link – hydraulic shaper - feed mechanism - work holding devices – fixture - operations.</p> <p><b>Slotter:</b> Introduction – specifications - method of operation - Whitworth quick return mechanism - feed mechanism - work holding devices - types of tools.</p> <p><b>Broaching:</b> Types of broaching machine - horizontal, vertical and continuous broaching - principles of operation - types of broaches – classification - broach tool nomenclature - broaching operations.</p> | <b>14</b> |
| <b>III</b> | <p><b>MILLING MACHINES AND GEAR GENERATING PROCESSES</b></p> <p><b>Milling Machines:</b> Types - column and knee type – plain - universal milling machine - vertical milling machine - principles of operation - specification of milling machines - work holding devices - tool holding devices - arbor - stub arbor - spring collet – adapter. Milling cutters: cylindrical milling cutter - slitting cutter -side milling cutter - angle milling cutter - T-slot milling cutter - woodruff milling cutter - fly cutter - nomenclature of cylindrical milling cutter. Milling operations: straddle milling - gang milling - vertical milling attachment.</p> <p>Indexing plate – differential indexing - simple indexing – compound indexing – simple problems.</p> <p><b>Generating Process:</b> gear shaper - gear hobbing - principle of</p>                                                                        | <b>14</b> |

|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |           |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|           | operation only. Gear finishing processes: burnishing – shaving - grinding and lapping - gear materials.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |           |
| <b>IV</b> | <p><b>ABRASIVE PROCESS AND NON- CONVENTIONAL MACHINING PROCESSES</b></p> <p><b>Abrasive Process:</b> Types and classification – specifications - rough grinding – pedestal grinders - portable grinders - belt grinders - precision grinding - cylindrical grinder - centerless grinders – surface grinder - tool and cutter grinder - planetary grinders - principles of operations - grinding wheels – abrasives - natural and artificial diamond wheels - types of bonds - grit, grade and structure of wheels - wheel shapes and sizes - standard marking systems of grinding wheels - selection of grinding wheel - mounting of grinding wheels - Dressing and Truing of wheels - Balancing of grinding wheels.</p> <p><b>Non-Conventional Machining Processes:</b> Construction, working and applications of Ultrasonic machining - chemical machining - electro chemical grinding - electrical discharge machining - plasma arc machining - LASER machining - Advantages – Disadvantages.</p> | <b>13</b> |
| <b>V</b>  | <p><b>CNC MACHINE AND ITS COMPONENTS</b></p> <p><b>CNC Machines:</b> Numerical control – definition – 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 centre – machine axes conventions turning centre and machining centre – Coordinate measuring machine – construction and working principle.</p> <p><b>Components of CNC machine:</b> Slide ways – requirement – types – friction slide ways and antifriction slide ways - linear motion bearings – recirculation ball screw – ATC – tool magazine – feedback devices – linear and rotary transducers – Encoders - in process probing - tool material – tool inserts.</p>                                                                                                                                                                                      | <b>13</b> |

**Text Book:**

1. Elements of Workshop Technology- Vol. I & II, Hajra Choudry & Battacharya, Edn. 11, published by Media Promoters and Publishers Pvt. Ltd., Seervai Buildings 'B', 20-G, Noshir Bharucha Marg, Mumbai 400 007 – 2007.
2. Production Technology, Jain & Gupta, Khanna Publishers, 2-B, North Market, Naisarak, New Delhi – 110 006 – 2006.

**Reference Book:**

1. Production Technology, HMT, Edn. 18, published by Tata McGraw Hill Publishing Co. Ltd., 7, West Patel Nagar, New Delhi 110 008.
2. Manufacturing process, Myro N Begman, , Edn. 5, Tata McGraw Hill Publishing Co. Ltd., 7, West Patel Nagar, New Delhi 110 008.
3. Workshop Tech Vol I,II, III, WAJ. Chapman, published by Viva Books Pvt. Ltd., 4262/3, Ansari Road, Daryaganj, New Delhi 110 002.
4. Production processes, NITTTR, published by 5, Tata McGraw Hill Publishing Co. Ltd., West Patel Nagar, New Delhi 110 008.
5. Principles of the manufacturing of Composite materials – Suong V Hoa, DES tech publication. Inc, 439, North Duke street, Lancaster, Pennsylvania – 17602 U.S.A.



DIRECTORATE OF TECHNICAL EDUCATION  
DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)

M SCHEME  
2015 -2016 onwards

II YEAR  
IV SEMESTER

**32043 – FLUID MECHANICS AND FLUID POWER**

CURRICULUM DEVELOPMENT CENTRE

## M-SCHEME

(Implements from the Academic year 2015-2016 onwards)

**Course Name** : DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)  
**Course Code** : 1221  
**Subject Code** : 32043  
**Semester** : IV  
**Subject Title** : FLUID MECHANICS & FLUID POWER

### TEACHING AND SCHEME OF EXAMINATIONS:

No. of Weeks per Semester: 15 Weeks

| Subject                         | Instructions   |                    | Examination            |                      |       |          |
|---------------------------------|----------------|--------------------|------------------------|----------------------|-------|----------|
| Fluid Mechanics and Fluid Power | Hours/<br>Week | Hours/<br>Semester | Marks                  |                      |       | Duration |
|                                 | 5              | 75                 | Internal<br>Assessment | Board<br>Examination | Total | 3 Hrs    |
|                                 |                |                    | 25                     | 75                   | 100   |          |

### Topics and Allocation of Hours:

| Unit | Topics                                                                  | Hours |
|------|-------------------------------------------------------------------------|-------|
| I    | PROPERTIES OF FLUIDS AND PRESSURE MEASUREMENTS                          | 14    |
| II   | FLOW OF FLUIDS AND FLOW THROUGH PIPES                                   | 14    |
| III  | IMPACT OF JETS, HYDRAULIC TURBINES, CENTRIFUGAL AND RECIPROCATING PUMPS | 14    |
| IV   | PNEUMATIC SYSTEMS                                                       | 13    |
| V    | HYDRAULIC SYSTEMS                                                       | 13    |
|      | TEST AND REVISION                                                       | 7     |
|      | Total                                                                   | 75    |

**RATIONALE:**

The main objective of this subject Fluid mechanics and Fluid power is to study the behavior of fluids under the condition of rest and motion. This chapter deals with fluid pumps, turbines, hydraulic and pneumatic operation. The overall object is to impart knowledge of pumps, hydraulic and pneumatic operation of tools and equipments.

**OBJECTIVES:**

- Define the properties of Fluids.
- Explain the working of pressure measuring devices
- Explain continuity equation and Bernoulli's Theorem
- Assess the impact of frictional loss of head in flow through pipes
- Estimate the discharge through orifices
- Distinguish the working principles of pumps and turbines.
- Explain the working of centrifugal pumps and reciprocating pumps.
- Compare pneumatic system with hydraulic system
- Draw Pneumatic circuits for industrial application.
- State the properties of hydraulic Systems
- Develop hydraulic circuit for machine tools applications.

**FLUID MECHANICS & FLUID POWER  
DETAILED SYLLABUS**

**Contents: Theory**

| Unit | Name of the Topic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Hours |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| I    | <b>PROPERTIES OF FLUIDS AND PRESSURE MEASUREMENTS</b><br>Introduction - Definition of fluid - Classification of Fluids - ideal and real fluids -Properties of a fluid – definition and units - Pressure-units of Pressure - Pressure head-atmospheric, gauge and absolute pressure – problems - Pascal's law- proof - applications of Pascal's law - Hydraulic press - Hydraulic jack - Pressure measurement - Piezometer tube - Simple U-tube manometer - Differential U-tube manometer - Inverted Differential manometer - Micro-manometer - Inclined tube micro-manometer - Mechanical Gauges -Bourdon's Tube | 14    |

|            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |           |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|            | Pressure Gauge - Diaphragm pressure gauge - Dead weight pressure gauge.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |           |
| <b>II</b>  | <b>FLOW OF FLUIDS AND FLOW THROUGH PIPES</b><br>Types of fluid flow - path line and stream line - mean velocity of flow - discharge of a flowing fluid - equation of continuity of fluid flow - energies of fluid - Bernoulli's theorem - statement, assumptions and proof - applications and limitations of Bernoulli's theorem - problems on Bernoulli's theorem – venturimeter - derivation for discharge - orifice meter - derivation for discharge - difference between venturimeter and orifice meter - problems on venturimeter and orifice meter - Pitot tube – description only – orifice –types – applications - hydraulic co-efficient - determining hydraulic co-efficient – problems - discharge through a small orifice discharging freely only - problems – experimental method of finding $C_v$ , $C_c$ and $C_d$ - Flow through pipes - laws of fluid friction - hydraulic gradient line - total energy line - wetted perimeter - hydraulic mean radius - loss of head due to friction – Darcy - Weisbach equation and Chezy's formula –problems - minor losses (description only) - Power transmission through pipes - problems. | <b>14</b> |
| <b>III</b> | <b>IMPACT OF JETS, HYDRAULIC TURBINES, CENTRIFUGAL AND RECIPROCATING PUMPS</b><br>Impact of jet - on a stationary flat plate held normal to the jet and inclined to the direction of jet - Impact of jet on a flat plate moving in the direction of jet - Impact of jet on a series of moving plates or vanes - force exerted and work done by the jet - problems. Hydraulic turbines – classifications - Pelton wheel - components and working - speed regulation (theory only) - Francis and Kaplan turbines - components and working - draft tube - functions and types - surge tank - differences between impulse and reaction turbines.<br>Centrifugal Pumps – classifications - construction and working of single stage centrifugal pumps - components with types - theory only - multi stage pumps – advantages - priming – cavitation.                                                                                                                                                                                                                                                                                                    | <b>14</b> |

|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |           |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|           | <p>Reciprocating Pumps – classifications - construction and working of single acting and double acting reciprocating pumps - plunger and piston pumps - discharge of a reciprocating pump - theoretical power required - coefficient of discharge – slip – problems - negative slip - indicator diagram – separation - air vessel (functions and working) - Special pumps - Jet pump - Turbine pump - Submersible pump.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |           |
| <b>IV</b> | <p><b>PNEUMATIC SYSTEMS</b></p> <p>Pneumatic Systems – elements – filter – regulator - lubricator unit - pressure control valves - pressure relief valves - pressure regulation valves - directional control valves - 3/2 DCV - 5/2 DCV – 5/3 DCV flow control valves – throttle valves – shuttle valves – quick exhaust valves – ISO symbols of pneumatic components – pneumatic circuits – direct control of single acting cylinder – operation of double acting cylinder – operation of double acting cylinder with metering-in control - operation of double acting cylinder with metering-out control – use of shuttle valve in pneumatic circuits – use of quick exhaust valve in pneumatic circuits - automatic operation of double acting cylinder single cycle – multiple cycle – merits and demerits of pneumatic system - applications.</p>                                                    | <b>13</b> |
| <b>V</b>  | <p><b>HYDRAULIC SYSTEMS</b></p> <p>Hydraulic system – Merits and demerits – Service properties of hydraulic fluids Hydraulic accumulators – Weight of gravity type accumulator – Spring loaded type accumulator - Gas filled accumulator – Pressure intensifier – Fluid power pumps – External and internal gear pump, Vane pump, Radial piston pump – ISO symbols for hydraulic components – Hydraulic actuators – Cylinders and motors – Valves – Pressure control valves, Flow control valves and direction control valves – types – including 4/2 DCV and 4/3 DCV – their location in the circuit.</p> <p>Hydraulic operation of double acting cylinder with metering-in and metering-out control – application of hydraulic circuits – Hydraulic circuit for - shaping machine - table movement in surface grinding machine and milling machine – comparison of hydraulic and pneumatic systems.</p> | <b>13</b> |

**Text Books :**

- 1) A Text Book of Hydraulics, Fluid Mechanics and Hydraulic Machines, R.S. Khurmi, - Edn.18, S.Chand & Co., Ram Nagar, New Delhi – 110 055, Ram Nagar, New Delhi
- 2) A Text Book of Fluid Mechanics and Hydraulic Machines – by, R. K Rajput and S.Chand & Co, Ram Nagar, New Delhi – 110 055.

**Reference Books:**

- 1) Hydraulic Machines, Jagadishlal, , Metropolitan Book Co. Pvt. Ltd., 1, Faiz Bazaar, New Delhi – 110 006.
- 2) Hydraulics, Andrew Parr (A Technician's and Engineer's Guide)
- 3) Fundamentals of pneumatic control Engineering -FESTO Manual
- 4) Fluid Mechanics and Hydraulic Machines, R. K. Bansal, Laxmi Publications Pvt., Ltd, 22, Golden House, Daryaganj, New Delhi – 110 002



DIRECTORATE OF TECHNICAL EDUCATION  
DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)

M SCHEME  
2015 -2016 onwards

II YEAR  
IV SEMESTER

**32044 – ELECTRICAL DRIVES AND CONTROL**

CURRICULUM DEVELOPMENT CENTRE

## M-SCHEME

(Implements from the Academic year 2015-2016 onwards)

**Course Name** : DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)  
**Course Code** : 1221  
**Subject Code** : 32044  
**Semester** : IV  
**Subject Title** : ELECTRICAL DRIVES AND CONTROL

### TEACHING AND SCHEME OF EXAMINATIONS:

No. of Weeks per Semester: 15 Weeks

| Subject                          | Instructions   |                    | Examination            |                      |       |          |
|----------------------------------|----------------|--------------------|------------------------|----------------------|-------|----------|
| Electrical Drives<br>and Control | Hours/<br>Week | Hours/<br>Semester | Marks                  |                      |       | Duration |
|                                  | 6              | 90                 | Internal<br>Assessment | Board<br>Examination | Total | 3 Hrs    |
|                                  |                |                    | 25                     | 75                   | 100   |          |

### Topics and Allocation of Hours:

| Unit | Topics                            | Hours     |
|------|-----------------------------------|-----------|
| I    | DC CIRCUITS AND DC MACHINES       | 17        |
| II   | AC CIRCUITS AND AC MACHINES       | 17        |
| III  | STEPPER AND SERVO MOTORS & DRIVES | 17        |
| IV   | POWER SUPPLIES AND LOGIC GATES    | 16        |
| V    | CONTROL ELEMENTS AND PLC          | 16        |
|      | TEST AND REVISION                 | 7         |
|      | <b>Total</b>                      | <b>90</b> |

### RATIONALE:

The automation is being the order of the day to improve the production with high quality consciousness. Such automation involves electrically operated switches, sensors controlled through electrically driven motors and actuators. The subject aims in introducing the basic electrical DC and AC circuits and motors and also focuses

on the various special control devices like stepper, servo drives and its controlling elements.

#### **OBJECTIVES:**

- Explore fundamental electric circuit laws.
- Explain the working principle of DC and AC Electrical machines.
- Identify the effective uses of drives of Electrical machines.
- Analyze the various power supply circuits.
- Select the field controlled elements.
- Explain the construction and working of Transformer.
- Compare the different types of Logic gates.
- Appreciate the safety practices followed in Electrical system.
- Compare the use of servo motors and stepper motors in electrical driving system
- Identify PLC Input outputs.
- Identify the use of Control elements.

### **ELECTRICAL DRIVES & CONTROL DETAILED SYLLABUS**

#### **Contents: Theory**

| <b>Unit</b> | <b>Name of the Topic</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>Hours</b> |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>I</b>    | <b>DC CIRCUITS AND DC MACHINES</b><br><br>Definition- Electric current, voltage and resistance -Ohm's law and Kirchoff's law. Resistance in series and parallel and series, parallel – simple problems electromagnetism(definitions only ) – magnetic flux, flux density magnetic field intensity, MMF, permeability, reluctance, Faraday's law of electromagnetic induction, electrical and mechanical units<br><br>DC generators – construction, principle of operation, types and application.<br><br>DC motors: - construction, principle of operation, types and application.<br><br>Necessity of starters: Three point, four point starters. | <b>17</b>    |

|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |    |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| II  | <p><b>AC CIRCUITS AND AC MACHINES</b></p> <p>Fundamentals of AC voltage, and current – peak, average, RMS value of sine wave, frequency, time period, amplitude, power and power factor (definition only)- star and delta connection relationship between phase, line voltage and current in star and delta connections.</p> <p>Transformer: Principle of operation and construction – EMF equation (no definition)- losses in Transformer – efficiency – application.</p> <p>Alternator construction – principle of operation – types and applications.</p> <p>AC machine: AC motors- Principle of operation of single phase capacitor start and universal motor induction motor- applications- Three phase induction motors – Squirrel cage and slip ring Induction motors (construction and working principle only) - application – speed control of 3<math>\Phi</math> Induction motor -Necessity of starters – DOL and star/delta starter.</p> | 17 |
| III | <p><b>STEPPER AND SERVO MOTORS &amp; DRIVES:</b></p> <p>PMDC, Stepper motor- construction and working principle and applications - Servo motor – types: brushless servo motor, permanent magnet servo motor construction and applications.</p> <p>Industrial drives- types, group drive, individual drive, multi motor drive, block diagram of Variable frequency drive , stepper motor drive: single stepping and half stepping. Servo drives.</p> <p>Electrical safety: - importance of earthing - electric shock: first aid, precautions - causes of accident and their preventive measures.</p> <p>Energy conservation</p>                                                                                                                                                                                                                                                                                                                      | 17 |
| IV  | <p><b>POWER SUPPLIES AND LOGIC GATES</b></p> <p>Diode – terminals: anode and cathode, forward biasing and reverse biasing – use of diode in rectifiers – half wave and full wave – necessity of filters- Regulated power supplies: IC voltage regulators – SMPS, UPS and Inverters – General description and their applications.</p> <p>Display devices – LED, 7 segment LED, LCD</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 16 |

|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |           |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|          | Logic gates: Positive and negative logic, definition, symbol truth table, Boolean expression for OR, AND, NOT, NOR, NAND, EXOR AND EXNOR gates – Universal logic Gates: NAND, and NOR.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |           |
| <b>V</b> | <b>CONTROL ELEMENTS AND PLC</b><br>Fuses – selection of fuse – necessity of fuse- fuse switch units.<br>Sensors: Photo electric sensor, Inductive proximity sensors, Temperature sensors.<br>Switches: Push button switch, selector switch, limit switch, pressure switch, temperature switch, float switch and reed switch.<br>Relays – NO, NC – usage- bimetallic thermal overload relays.<br>Contactors- usage – necessity of contactor- Solenoid type contactor<br>Circuit breakers – Miniature case Circuit breaker (MCCB) and Miniature Circuit breaker (MCB), Oil Circuit breakers (OCB), Earth leakage circuit breaker (ELCB)<br>Features of PLC-PLC Block diagram- PLC scan - Fixed and modular PLC Ladder logic-NO, NC contacts-Coils-AND, OR. | <b>16</b> |

#### **Text Books:**

- 1) A course in electrical engineering - B.L.Theraja - Multi Colour Edition, S Chand & Co, Reprint 2006
- 2) Control of Machines - S.K Bhattacharya, Brijinder Singh – New Age Publishers, Second Edition- Reprint 2010
- 3) Electronic Circuits & System- Analog and Digital – Y.N.Bapat - Tata Mc Graw Hill.

#### **Reference Books:**

- 1) Electrical Technology – Hughes - 8th Edition, Pearson Education.
- 2) Electronic Device and Circuits- An introduction – Allen Mottershed - Prentice Hall of India.



DIRECTORATE OF TECHNICAL EDUCATION  
DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)

M SCHEME  
2015 -2016 onwards

II YEAR  
IV SEMESTER

**32045 – STRENGTH OF MATERIALS AND  
FLUID MECHANICS PRACTICAL**

CURRICULUM DEVELOPMENT CENTRE

## M-SCHEME

(Implements from the Academic year 2015-2016 onwards)

**Course Name** : DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)  
**Course Code** : 1221  
**Subject Code** : 32045  
**Semester** : IV  
**Subject Title** : STRENGTH OF MATERIALS AND FLUID MECHANICS PRACTICAL

### TEACHING AND SCHEME OF EXAMINATIONS:

No. of Weeks per Semester: 15 Weeks

| Subject                                                      | Instructions   |                    | Examination            |                      |       |          |
|--------------------------------------------------------------|----------------|--------------------|------------------------|----------------------|-------|----------|
|                                                              | Hours/<br>Week | Hours/<br>Semester | Marks                  |                      |       | Duration |
| Strength of<br>Materials and<br>Fluid Mechanics<br>Practical | 4              | 90                 | Internal<br>Assessment | Board<br>Examination | Total | 3 Hrs    |
|                                                              |                |                    | 25                     | 75                   | 100   |          |

### OBJECTIVES:

- Acquire skills on different types of testing methods of metals.
- Conduct material testing on elasticity, hardness, shear strength
- Determine modulus of rigidity of open spring and closed coil springs.
- Determine the co-efficient of discharge of venturimeter, orifice meter, mouth piece and orifice.
- Determine the co-efficient of friction in pipes.
- Conduct performance test on centrifugal and reciprocating pumps.
- Conduct performance test on impulse and reaction turbines.

## **Strength of Materials Laboratory**

### **Exercises**

#### **1. Test on Ductile Materials:**

Finding Young's Modulus of Elasticity, yield points, percentage elongation and percentage reduction in area, stress strain diagram plotting, tests on mild steel.

#### **2. Hardness Test:**

Determination of Rockwell's Hardness Number for various materials like mild steel, high carbon steel, brass, copper and aluminium.

#### **3. Torsion test:**

Torsion test on mild steel – relation between torque and angle of twist-determination of shear modulus and shear stress.

#### **4. Impact test:**

Finding the resistance of materials to impact loads by Izod test and Charpy test.

#### **5. Tests on springs of circular section:**

Determination of modulus of rigidity, strain energy, shear stress and stiffness by load deflection method (Open / Closed coil spring)

#### **6. Shear test:**

Single or double shear test on M.S. bar to finding the resistance of material to shear load.

## **Fluid Mechanics Laboratory**

### **Exercises**

1. Verify the Bernoulli's Theorem.
2. Determination of co-efficient of discharge of a mouth piece / orifice by variable head method.
3. Determination of co-efficient of discharge of a venturimeter / orificemeter.
4. Determination of the friction factor in a pipe.
5. Performance test on reciprocating pump / centrifugal pump and to draw the characteristics curves.
6. Performance test on impulse turbine / reaction turbine and to find out the Efficiency.

## BOARD EXAMINATION

**Note:** All the exercises in both sections have to be completed. Two exercises will be given for examination by selecting one exercise in each section.

All the exercises should be given in the question paper and students are allowed to select by a lot.

Record note book should be submitted during examination.

### Detailed allocation

#### **Strength of material lab**

|                          |   |                 |
|--------------------------|---|-----------------|
| <b>Part A</b>            | - | <b>35 marks</b> |
| Observation              | - | 10              |
| Tabulation / Calculation | - | 20              |
| Result / Graph           | - | 5               |

#### **Fluid mechanics lab**

|                          |   |                 |
|--------------------------|---|-----------------|
| <b>Part B</b>            | - | <b>35 marks</b> |
| Observation              | - | 10              |
| Tabulation / Calculation | - | 20              |
| Result / Graph           | - | 5               |
| <b>Viva-voce</b>         | - | <b>05 marks</b> |
| <b>Total</b>             | - | <b>75 marks</b> |

## LIST OF EQUIPMENTS

|                                                                                                                                        |    |
|----------------------------------------------------------------------------------------------------------------------------------------|----|
| 1. UTM                                                                                                                                 | 01 |
| 2. Rockwell's Hardness Testing Machine                                                                                                 | 01 |
| 3. Torsion testing machine                                                                                                             | 01 |
| 4. Impact testing machine                                                                                                              | 01 |
| 5. Spring testing arrangements                                                                                                         | 01 |
| 6. Shear testing machine                                                                                                               | 01 |
| 7. Vernier calliper                                                                                                                    | 02 |
| 8. The Bernoulli's Apparatus                                                                                                           | 01 |
| 9. An Open tank fitted with a small orifice /<br>an external mouth piece and a collecting tank<br>with Piezometer                      | 01 |
| 10. A Centrifugal pump having the discharge line<br>with venturimeter / orifice meter arrangement                                      | 01 |
| 11. An arrangement to find friction factor of pipe                                                                                     | 01 |
| 12. A reciprocating pump with an arrangement for<br>collecting data to find out the efficiency and<br>plot the characteristics curves. | 01 |
| 13. A centrifugal pump with an arrangement<br>for collecting tank to find out the efficiency and<br>plot the characteristics curves.   | 01 |
| 14. A impulse turbine with an arrangement for<br>calculating data to find out the efficiency                                           | 01 |
| 15. A reaction turbine with an arrangement<br>for collecting data to find out the efficiency                                           | 01 |



DIRECTORATE OF TECHNICAL EDUCATION  
DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)

M SCHEME  
2015 -2016 onwards

II YEAR  
IV SEMESTER

**32046 – SPECIAL MACHINES PRACTICAL**

CURRICULUM DEVELOPMENT CENTRE

## M-SCHEME

(Implements from the Academic year 2015-2016 onwards)

**Course Name** : DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)  
**Course Code** : 1221  
**Subject Code** : 32046  
**Semester** : IV  
**Subject Title** : **SPECIAL MACHINES PRACTICAL**

### TEACHING AND SCHEME OF EXAMINATIONS:

No. of weeks per semester: 15 Weeks

| Subject                          | Instructions   |                    | Examination            |                      |       |          |
|----------------------------------|----------------|--------------------|------------------------|----------------------|-------|----------|
| Special<br>Machines<br>Practical | Hours/<br>Week | Hours/<br>Semester | Marks                  |                      |       | Duration |
|                                  | 4              | 60                 | Internal<br>Assessment | Board<br>Examination | Total | 3 Hrs    |
|                                  |                |                    | 25                     | 75                   | 100   |          |

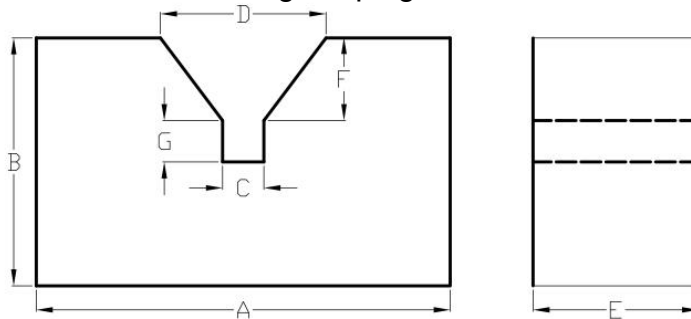
### OBJECTIVES:

- Identify a milling machine and its parts
- Identify a cylindrical grinder, surface grinder and tool and cutter grinder
- Identify shaper, Slotter and its parts
- Identify the tools and instruments used in milling.
- Handle the different types of work holding devices
- Machine a component using different machine tools.
- Calculate the indexing for a work
- Machine a gear using milling machine.
- Machine a cutting tool using Tool and Cutter grinder.
- Machine a plug gauge using Cylindrical grinding machine.
- Machine components by shaping machine
- Machine components by slotting machine
- Prepare a record of work for all the exercises.

## EXERCISES:

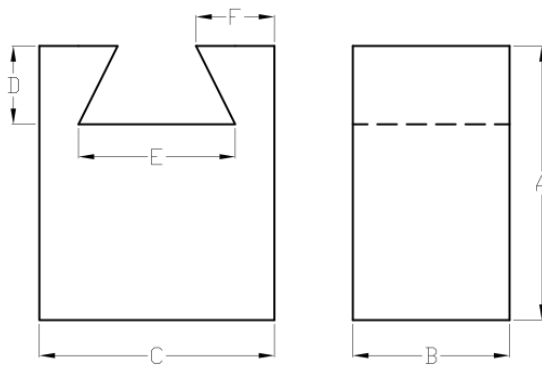
Raw Material: M.S. / C.I

1. Make 'V' Block using shaping machine



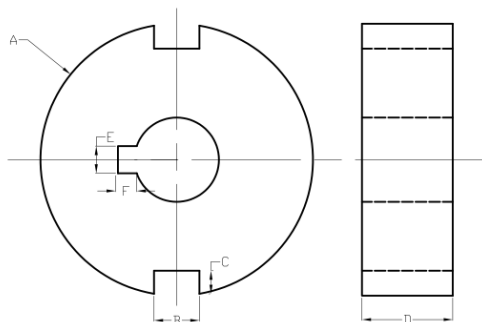
| Dimensions |           |        |          |
|------------|-----------|--------|----------|
| Sl.No      | Part Name | Actual | Obtained |
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|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |

2. Make dovetail using shaping machine



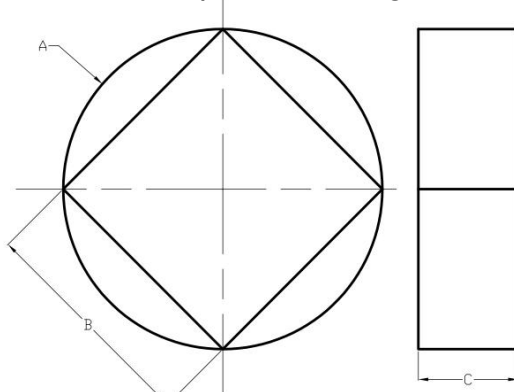
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| Sl.No      | Part Name | Actual | Obtained |
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|            |           |        |          |
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|            |           |        |          |

3. Make groove cut using slotting machine



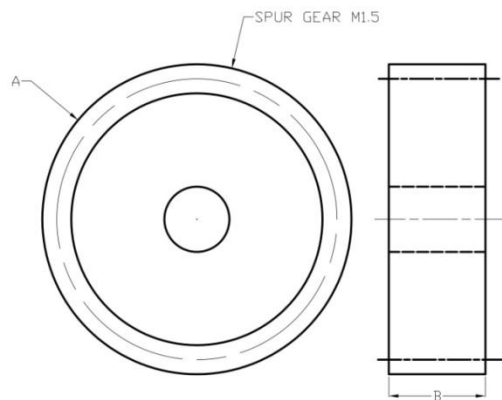
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| Sl.No      | Part Name | Actual | Obtained |
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4. Make round to square in milling machine.



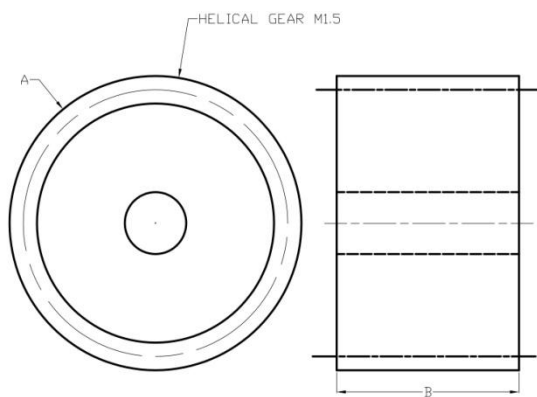
| Dimensions |           |        |          |
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| Sl.No      | Part Name | Actual | Obtained |
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|            |           |        |          |
|            |           |        |          |

5. Make Spur Gear using milling machine by Differential Indexing.



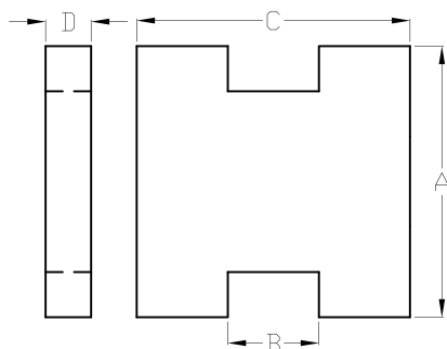
| Dimensions |           |        |          |
|------------|-----------|--------|----------|
| Sl.No      | Part Name | Actual | Obtained |
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|            |           |        |          |
|            |           |        |          |
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|            |           |        |          |
|            |           |        |          |

6. Make Helical Gear using milling machine



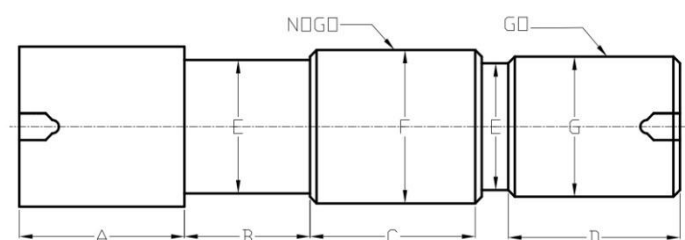
| Dimensions |           |        |          |
|------------|-----------|--------|----------|
| Sl.No      | Part Name | Actual | Obtained |
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|            |           |        |          |
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7. Make slot cut using milling machine.



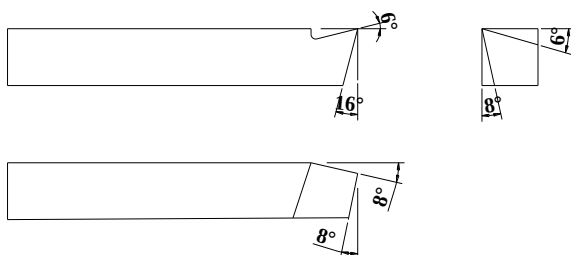
| Dimensions |           |        |          |
|------------|-----------|--------|----------|
| Sl.No      | Part Name | Actual | Obtained |
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|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |

8. Make Progressive type Plug gauge using Cylindrical Grinding machine



| Dimensions |           |        |          |
|------------|-----------|--------|----------|
| Sl.No      | Part Name | Actual | Obtained |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |

9. Make a turning tool using Tool and Cutter Grinder



| Dimensions |           |        |          |
|------------|-----------|--------|----------|
| Sl.No      | Part Name | Actual | Obtained |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |

10. Make plain surfaces (four surfaces) using surface Grinder



| Dimensions |           |        |          |
|------------|-----------|--------|----------|
| Sl.No      | Part Name | Actual | Obtained |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |
|            |           |        |          |

**BOARD EXAMINATION**

**Note:** All the exercises should be given in the question paper and students are allowed to select by a lot. Record note book must be submitted for the examination.

**ALLOCATION OF MARKS**

|                             |           |
|-----------------------------|-----------|
| Job preparation / Marking   | 15        |
| Setting / Operations        | 30        |
| Dimensions / Surface Finish | 25        |
| Viva voce                   | 5         |
| <b>Total</b>                | <b>75</b> |

**LIST OF EQUIPMENTS**

|                                                   |   |                      |
|---------------------------------------------------|---|----------------------|
| 1. Vertical milling machine / Vertical attachment | - | 2 Nos.               |
| 2. Universal Milling Machine                      | - | 2 Nos.               |
| 3. Surface Grinding Machine                       | - | 1 No.                |
| 4. Cylindrical Grinding Machine                   | - | 1 No.                |
| 5. Tool and Cutter Grinder                        | - | 1 No.                |
| 6. Shaping Machine                                | - | 2 Nos.               |
| 7. Slotting Machine                               | - | 1 No.                |
| 8. Tools and Measuring instruments                | - | Sufficient quantity. |
| 9. Consumables                                    | - | Sufficient quantity  |



**DIRECTORATE OF TECHNICAL EDUCATION  
DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)**

**M SCHEME  
2015 -2016 onwards**

**II YEAR  
IV SEMESTER**

**32047 – ELECTRICAL DRIVES AND CONTROL  
PRACTICAL**

**CURRICULUM DEVELOPMENT CENTRE**

## M-SCHEME

(Implements from the Academic year 2015-2016 onwards)

**Course Name** : DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)  
**Course Code** : 1221  
**Subject Code** : 32047  
**Semester** : IV  
**Subject Title** : ELECTRICAL DRIVES AND CONTROL PRACTICAL

### TEACHING AND SCHEME OF EXAMINATIONS:

No. of Weeks per Semester: 15 Weeks

| Subject                                       | Instructions   |                    | Examination            |                      |       |          |
|-----------------------------------------------|----------------|--------------------|------------------------|----------------------|-------|----------|
| Electrical Drives<br>and Control<br>Practical | Hours/<br>Week | Hours/<br>Semester | Marks                  |                      |       | Duration |
|                                               | 4              | 60                 | Internal<br>Assessment | Board<br>Examination | Total | 3 Hrs    |
|                                               |                |                    | 25                     | 75                   | 100   |          |

### OBJECTIVES:

- Identify starters for different motors.
- Study and prepare earthing
- Test the characteristics of DC and AC machines.
- Identify and select controlling elements.
- Explore the performance of ELCB, MCB.
- Design regulated power supplies.
- Identify display devices - LED, 7 segment LED, LCD.
- Identify the drive circuit for special motors.
- Test the speed control circuit of the special motors

## **LIST OF EXPERIMENTS:**

### **Part A:**

1. Verification of Ohm's Law
2. Testing of DC starters – 3 point and 4 point starter
3. Load test on DC shunt motor
4. Testing of AC starters - DOL , star - Delta starter
5. Load test on single phase induction motor
6. Load test on three phase squirrel cage motor
7. Testing of relays, contactors, push buttons and limit switch
8. Connection and Testing of MCB, ELCB

### **Part B**

9. Construction and testing of Half wave and Full wave rectifier.
10. Construction and testing of IC voltage regulator using IC 7805.
11. Verification of truth tables for logic gates.
12. Verification of universal gates.
13. Identification and testing of display devices- LED, 7 segment LED, Laser diode.
14. Testing of Stepper motor drive.
15. Testing of Servo motor drive.

## BOARD EXAMINATION

**Note: All the exercises are to be completed. One exercise from Part A and another one from Part B should be given for the Examination.**

|                |                        |           |
|----------------|------------------------|-----------|
| <b>Part A:</b> |                        | <b>35</b> |
|                | Circuit diagram        | 05        |
|                | Connections & Readings | 15        |
|                | Calculations & Graph   | 15        |
| <b>Part B:</b> |                        | <b>35</b> |
|                | Circuit diagram        | 05        |
|                | Connections & Readings | 15        |
|                | Execution              | 15        |
|                | <b>Viva Voce</b>       | <b>5</b>  |
| <b>Total</b>   |                        | <b>75</b> |

## LIST OF EQUIPMENTS

### Electrical Lab

|                                            |   |       |
|--------------------------------------------|---|-------|
| 1. DC ammeter 0-5A                         | - | 1no   |
| 2. DC ammeter 0-25A                        | - | 1no   |
| 3. DC voltmeter 0-30V                      | - | 1no   |
| 4. DC voltmeter 0-300V                     | - | 1no   |
| 5. Rheostat 10.8 ,8.5A                     | - | 1no   |
| 6. AC ammeter 0-5A                         | - | 1no   |
| 7. AC ammeter 0-10A                        | - | 2nos. |
| 8. AC voltmeter 0-50V                      | - | 3nos  |
| 9. AC wattmeter 5A-10A<br>(0-750W,0-600V)  | - | 3nos  |
| 10. Loading rheostat 5A,230V               | - | 1no   |
| 11. Tachometer 0-1000rpm<br>(Analog type)  | - | 1no   |
| 12. Variac 20A,250V<br>(Auto transformer ) | - | 2nos  |
| 13. 3 point starter 20A,220V               | - | 1no   |
| 14. DOL starter 16A,415V                   | - | 1no   |

|                                   |   |      |
|-----------------------------------|---|------|
| 15. Star /Delta starter 20a,600V  | - | 1no  |
| 16. Over load relay 1 to 2.5A     | - | 1no  |
| 17. Air break contactors 20A,220V | - | 4nos |
| 18. Push button 2A ,220V          | - | 2nos |
| 19. Limit switch 20A,220V         | - | 1no  |
| 20. MCB 20A single pole           | - | 1no  |
| 21. MCB 20A double pole           | - | 1no  |
| 22. ELCB 2pole 20A,100mA          | - | 1no  |
| 23. ELCB 4POLE 20A,100mA          | - | 1no  |

### **Electronics Lab**

|                                     |   |        |
|-------------------------------------|---|--------|
| 1. Transformer 230 / 9-0-9V, 1A     | - | 4 nos. |
| 2. Resistor 1 K $\Omega$ / ½ W      | - | 3 nos. |
| 3. Capacitor 1000 $\mu$ F/25V       | - | 4 nos. |
| 4. IC 7805                          | - | 1 no.  |
| 5. Logic Gates IC                   |   |        |
| 7400, 7408, 7432, 7404, 7402, 7486- |   | 1 each |
| 6. Stepper Motor Drive kit          | - | 1no.   |
| 7. Servo Motor Drive Kit            | - | 1no    |
| 8. Digital Multimeter               | - | 1no.   |
| 9. LED, 7Segment LED, Laser Diode - |   | 1 each |



**V SEMESTER**



DIRECTORATE OF TECHNICAL EDUCATION  
DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)

M SCHEME  
2015 -2016 onwards

III YEAR  
V SEMESTER

**32451 REFRIGERATION**

CURRICULUM DEVELOPMENT CENTRE

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

**DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)**

**M-SCHEME**

(to be Implemented for the students Admitted from the Year 2015-2016 onwards)

Course Name : Diploma in Mechanical Engineering(R&A/C)

Subject Code : 32451

Semester : V Semester

Subject Title : **REFRIGERATION**

**TEACHING AND SCHEME OF EXAMINATIONS :**

No. of weeks per Semester : 15 Weeks

| Subject       | Instructions  |                     | Examination            |                      |       |          |
|---------------|---------------|---------------------|------------------------|----------------------|-------|----------|
|               | Hours<br>Week | Hours /<br>Semester | Marks                  |                      |       | Duration |
| REFRIGERATION | 6 Hrs         | 90 Hrs              | Internal<br>Assessment | Board<br>Examination | Total |          |
|               |               |                     | 25                     | 75                   | 100   |          |

**TOPICS AND ALLOCATION OF HOURS**

| SL.NO | Topic                         | TIME (Hrs.) |
|-------|-------------------------------|-------------|
| 1.    | Review of Basics              | 17          |
| 2.    | Vapour Compression System     | 17          |
| 3.    | Refrigerants                  | 17          |
| 4.    | Low Temperature Refrigeration | 16          |
| 5.    | Other Refrigeration Cycles    | 16          |
| 6.    | TEST & REVISION               | 07          |
| Total |                               | 90          |

**Rationale :**

Basic understanding of refrigeration, refrigeration methods used in industry, calculation of refrigeration capacity by using charts and tables. To acquire knowledge about refrigerants and instruments used in industry. To also impart knowledge about low temperature applications, methods of defrosting.

**Objectives :**

- ❖ To understand the limitations of Compression cycles & method of producing low temperature
- ❖ To understand basic concepts of Vapour compression system and capacity calculation using relevant tables and charts
- ❖ To acquire knowledge of refrigerants and instruments and its environmental factors
- ❖ Learn about low temperature production and its Industrial applications
- ❖ To understand the concepts of non conventional refrigeration system & defrosting methods.

## **32451- REFRIGERATION**

### **DETAILED SYLLABUS**

#### **CONTENTS**

| <b>UNIT</b> | <b>NAME OF THE TOPICS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>Hours</b> |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| I           | <b>REVIEW OF BASICS</b><br>Definition of refrigeration, refrigeration effect and COP – Unit of refrigeration. Engine – heat supplied, heat rejected, work output, thermal efficiency, refrigerator – thermal efficiency – heat absorbed, heat rejected, relative COP, work input, COP, Heat pump – Heat absorbed, heat delivered, work input, EPR. Air refrigeration – Reversed carnot cycle – Bell coleman cycle with COP derivation – Simple problems.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 17           |
| II          | <b>VAPOUR COMPRESSION SYSTEM</b><br>Simple vapour compression system – basic components - representation of p-h and T-s diagram with refrigeration effect, work of compression, heat rejection, saturated liquid and vapour line, sub cooled liquid region, superheated vapour region.<br>Effect of liquid sub cooling and superheating, effect of varying suction and discharge pressure.<br><br>Actual vapour compression cycle – representation on ph & TS diagram – wet compression cycle with superheating and sub cooling - problems involving refrigeration effect, cooling capacity of heat of compression, theoretical power theoretical COP using refrigeration charts and tables.                                                                                                                                                                                                                                                                                                                                              | 17           |
| III         | <b>REFRIGERANTS</b><br>Refrigerant – classification of refrigerants – primary refrigerants - Halo carbon, chlorofloura carbons, Hydrocarbons, hydrochlora carbons, hydrofloura carbons, mixtures, azeotropes, Geotropes, near azeotrpes, inorganic refrigerants – Properties – Thermodynamic & Thermo physical properties (list only) – Boiling point, freezing point, Evaporator and condenser pressure, critical temp. and pressure, Latent heat, specific volume, specific heat of vapour and liquid, thermal conductivity, dielectric strength- Secondary refrigerants – brine solutions, ethylene glycol, propylene glycol – properties - odour, leak tendency, refrigerant oil miscibility, COP and power requirement cost and availability.<br>Safe working properties – Toxicity, flammability, corrosive property, chemical stability, effect on stored product – Environmental effects of Refrigerants- ozone depletion & global warming – total equivalent global warming impacts - Nano lubricants – facing out refrigerants. | 17           |
| IV          | <b>LOW TEMPERATURE REFRIGERATION</b><br>Limitations of vapour compression system – temperature limitation, evaporator pressure limitation, limitation of compressors operating at low specific volume and pressures, limitation of compression ratio. Limitation of power requirement per ton of refrigeration.<br><br>Multistage compression system – process, representation in p-h diagram,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 16           |

|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |    |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
|   | <p>Advantages and limitations - two stage cascade System – Process and representation in p-h diagram – derivation of COP for two stage system – advantages and applications of cascade system. Solid carbon dioxide – uses – economic production of solid CO<sub>2</sub> process. Joule Thompson effect – inversion temperature – applications in liquefaction of gases. Linde System – working of Linde system – Claude system</p> <p>Liquefaction of air by claudé system - Production of liquid Hydrogen – production of liquid Helium.</p> <p>Applications of low temperature – material properties – super conductivity, super fluidity, expansion fitting – cryobiology – preservation of biological materials – space propulsion, super insulation.</p> |    |
| V | <p><b>OTHER REFRIGERATION CYCLES</b></p> <p>Vapour absorption system – practical ammonia absorption system – Lithium Bromide System – Electrolux System – No derivation – No problems - Steam jet refrigeration – construction &amp; working – applications – no derivation &amp; no problems</p> <p>Thermoelectric effects – seebeck effect, peltier effect, Thomson effect. Required properties of thermoelectric materials in terms of electrical conductivity, thermal conductivity and rate of change of voltage with temperature. Thermoelectric refrigeration system – Advantages and disadvantages.</p>                                                                                                                                                | 16 |

#### Text Book

1. Refrigeration and Air – Conditioning by Arora and Domkundwar , Danpat Rai & Sons Publications

#### Reference Book

1. Principles of Refrigeration by Roy J Dossot.



DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)

M SCHEME  
2015 -2016 onwards

III YEAR  
V SEMESTER

**32452 - AIR CONDITIONING**

CURRICULUM DEVELOPMENT CENTRE

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

**DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)  
M-SCHEME**

(to be Implemented for the students Admitted from the Year 2015-2016 onwards)

Course Name : Diploma in Mechanical Engineering(R&A/C)

Subject Code : 32452

Semester : V Semester

Subject Title : **AIR CONDITIONING**

**TEACHING AND SCHEME OF EXAMINATION:**

No. of weeks per Semester : 15 Weeks

| Subject                     | Instructions   |                     | Examination            |                      |       |          |
|-----------------------------|----------------|---------------------|------------------------|----------------------|-------|----------|
|                             | Hours/<br>Week | Hours /<br>Semester | Marks                  |                      |       | Duration |
| <b>AIR<br/>CONDITIONING</b> | 6 Hrs          | 90 Hrs              | Internal<br>Assessment | Board<br>Examination | Total |          |
|                             |                |                     | 25                     | 75                   | 100   | 3 Hrs    |

**TOPICS AND ALLOCATION OF HOURS**

| Sl.No        | Topic                              | TIME (Hrs.) |
|--------------|------------------------------------|-------------|
| 1.           | Psychrometry                       | 17          |
| 2.           | Psychrometric processes            | 17          |
| 3.           | Indoor Air Quality                 | 17          |
| 4.           | Air conditioning load Calculations | 16          |
| 5.           | Air Conditioning Systems           | 16          |
| 6.           | TEST & REVISION                    | 07          |
| <b>Total</b> |                                    | <b>90</b>   |

**Rationale :**

To understand the basics of Psychrometry, Psychrometric processes, human comforts. To acquire knowledge about cooling load calculations, duct design and process calculation using psychrometric chart

**Objectives :**

- ❖ To understand basic concept of Psychrometry ( air properties ) & measuring instruments.
- ❖ Learn about Psychrometric processes such as heating, cooling, humidification, dehumidification and mixing of air streams

- ❖ Basic concept of human comfort condition and cooling load calculation
- ❖ To acquire knowledge about application of air conditioning
- ❖ To know about basics of duct systems and duct design

**32452 - AIR CONDITIONING**  
**DETAILED SYLLABUS**

**CONTENTS**

| <b>UNIT</b> | <b>NAME OF THE TOPICS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Hours</b> |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| I           | <b>Psychrometry</b><br><br>Psychrometry definition – dry air, moisture, moist air, psychrometric properties, dry bulb temperature(DBT), wet bulb temperature(WBT), dew point temperature (DPT), specific humidity (or) humidity ratio, absolute humidity, relative humidity, degree of saturation, humid specific volume, total heat of air – sensible heat of air, latent heat of water vapour, enthalpy of moist air.<br><br>Psychrometric relations – applications of Dalton’s law of partial pressure to moist air, derivation of relationship between specific humidity, partial pressure of water vapor and total pressure of moist air. Simple problems – Calculation of air properties using equations. Psychrometers – Laboratory Psychrometers, sling psychrometer, aspirating Psychrometers. | 17           |
| II          | <b>Psychrometric processes</b><br><br>Psychrometric chart – representation of psychrometric properties – DBT in specific humidity, constant RH lines, constant specific volume lines, constant enthalpy lines, constant WBT line and use of comfort cycle. Psychrometric processes - mixing of air streams, sensible heating, sensible cooling, cooling with dehumidification, cooling with adiabatic humidification of air, adiabatic chemical dehumidification, humidification by steam injection, heating and humidification - By pass factor – temperature distribution of air passing through coil, sensible heat given out by coil derivation of relationship between by pass factor and number of rows, apparatus dew point-Simple problems                                                      | 17           |
| III         | <b>Indoor Air Quality</b><br>Human comfort:<br>Requirements of comfort air conditioning – Oxygen supply, heat removal, moisture removal, air motion, purity of air– adaption of human body to variable climatic conditions, human body as thermal machine, thermal efficiency of human body, metabolic heat production, convective heat loss from body, heat lost by evaporation, radiation heat loss from body – ventilation standards for different A/C conditions - Effect of heat on work performance. Comfort and comfort chart – effective temperature, factors governing optimum effective temperature                                                                                                                                                                                           | 17           |
| IV          | <b>Air conditioning Load Calculations</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 16           |

|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |    |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
|   | <p>Cooling load calculation:</p> <p>Heat loads – sensible heat load and latent heat load</p> <p>Sensible heat load – wall gain load, sun load, sensible heat load from occupants, electrical equipment load, infiltration air and ventilation load, miscellaneous heat loads due to duct heat gain and fan load, fresh air load.</p> <p>Latent heat load – infiltrated air, ventilated air, latent heat load from occupants, load from hot cooked foods and stored materials, moisture gain through permeable walls and ceilings.</p> <p>Design of air conditioning system – sensible heat factor (SHF), cooling load and air quantities, all fresh air used, partly recirculated air, recirculation with by pass, recirculation after air conditioner, simple problems.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |    |
| V | <p><b>Air Conditioning Systems</b></p> <p>Types of air conditioning systems- Windows, Split, packaged, centralized- installation procedure – selection of A/C systems -Central air conditioning system – components, capacity. considerations, advantages. Unitary air conditioning systems – classification, remote air conditioning unit system, self contained air conditioning unit, unitary system for multi storey buildings, advantages of unitary system over central air conditioning.</p> <p>Factory air conditioning system – economics of factory air conditioning system Summer air conditioning systems – for hot and dry climates with cooling coil and adiabatic humidification, capacity of cooling coil and humidifier –psychrometric processess involved, representation in psychrometric chart For hot and humid condition with cooling and heating coils, capacity of cooling coil and heating coil, representation in psychrometric chart. Summer air conditioning with single cooling coil and mixing with recirculated air, representation in psychrometric chart. Summer air conditioning with air washer/desert cooler, representation in psychrometric chart. Winter air conditioning for severe winter with double reheat coils, humidifier and recirculated air, psychrometric processess involved, capacities of reheat coils and humidifier, representation in psychrometric chart. Year round air conditioning – components, psychrometric processess involved in summer and winter, working.</p> | 16 |

#### TEXT BOOK

1. Refrigeration and Air-conditioning by Arora and Domkundwar Danpat Rai & Sons Publications

#### REFERENCE BOOKS

1. Principles of refrigeration by Roy J Dossot
2. Refrigeration and Air-conditioning by C.P.Arora
3. Hand book of Air-conditioning by Stamper and Koral



DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)

M SCHEME  
2015 -2016 onwards

III YEAR  
V SEMESTER

**ELECTIVE THEORY**  
**(CRYOGENIC ENGINEERING)**

CURRICULUM DEVELOPMENT CENTRE

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

**DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)**

**M-SCHEME**

**ELECTIVE**

(to be Implemented for the students Admitted from the Year 2015-2016 onwards)

Course Name : Diploma in Mechanical Engineering(R&A/C)

Subject Code : 32471

Semester : V Semester

Subject Title : **CRYOGENIC ENGINEERING**

**TEACHING AND SCHEME OF EXAMINATION:**

No. of weeks per Semester : 15 Weeks

| Subject                          | Instructions   |                     | Examination            |                      |       |          |
|----------------------------------|----------------|---------------------|------------------------|----------------------|-------|----------|
|                                  | Hours/<br>Week | Hours /<br>Semester | Marks                  |                      |       | Duration |
| <b>CRYOGENIC<br/>ENGINEERING</b> | 5              | 75                  | Internal<br>Assessment | Board<br>Examination | Total |          |
|                                  |                |                     | 25                     | 75                   | 100   | 3 Hrs    |

**TOPICS AND ALLOCATION OF MARKS**

| Sl.No        | Topic                               | TIME (Hrs.) |
|--------------|-------------------------------------|-------------|
| 1            | Cryogenic Systems                   | 14          |
| 2            | Cryogenic Refrigeration Systems     | 14          |
| 3            | Separation and Purification Systems | 14          |
| 4            | Measurement Systems                 | 13          |
| 5            | Applications of Cryogenics          | 13          |
|              | TEST & REVISION                     | 07          |
| <b>Total</b> |                                     | <b>75</b>   |

**Rationale :**

To acquire knowledge about cryogenic systems like gas liquefaction and air liquefaction system. To impart knowledge about cryogenic refrigeration, measurement of low temperature and applications of cryogenics.

**Objectives :**

- ❖ To understand basic concepts of Cryogenics
- ❖ To learn about Cryogenics refrigeration systems
- ❖ To understand separation and purification of air process
- ❖ To learn measurement of low temperature and pressure
- ❖ To understand about Cryogenic applications.

**32471 - CRYOGENIC ENGINEERING**  
**DETAILED SYLLABUS**

**CONTENTS**

| <b>UNIT</b> | <b>NAME OF THE TOPICS</b>                                                                                                                                                                                                                          | <b>Hours</b> |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| I           | <b>Cryogenic Systems</b><br>Introduction to Refrigeration and Air conditioning systems. Cryogenics systems – Gas liquefaction systems. Simple Linde – Hampson systems – Claude system – System for neon, hydrogen and helium liquefaction systems. | 14           |
| II          | <b>Cryogenics Refrigeration Systems</b><br>Cryogenics refrigeration systems – Claude refrigerator, Philips refrigerator – Solvay refrigerator – Gifford – Magnetic cooling system – Magnetic refrigeration systems.                                | 14           |
| III         | <b>Separation and Purification Systems</b><br>Separation and Purification systems – Air separator systems – Linde double column systems Argon, Neon, Hydrogen and Helium separation systems                                                        | 14           |
| IV          | <b>Measurement Systems</b><br><br>Measurement systems for Temperature, Pressure, Liquid level measurement.                                                                                                                                         | 13           |
| V           | <b>Applications of Cryogenics</b><br><br>Applications of cryogenics – Rocket propulsion – Separation of Rubber from old tyres. Medical applications – Increasing the tool life application.                                                        | 13           |

**Text Book:**

1.Refrigeration & Air Conditioning – Domkundwar & Arrora Danpat Rai & Sons Publications

**Reference Books:**

1.Cryogenic Engineering by Barrans. A Tata Mc Graw Hill Publications



DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)

M SCHEME  
2015 -2016 onwards

III YEAR  
V SEMESTER

ELECTIVE THEORY  
**32472-REFRIGERATION AND AIR CONDITIONING  
APPLICATIONS**

CURRICULUM DEVELOPMENT CENTRE

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

**DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)**

**M-SCHEME**

**ELECTIVE**

(to be Implemented for the students Admitted from the Year 2015-2016 onwards)

Course Name : Diploma in Mechanical Engineering(R&A/C)

Subject Code : 32472

Semester : V Semester

Subject Title : **REFRIGERATION AND AIR CONDITIONING APPLICATIONS**

**TEACHING AND SCHEME OF EXAMINATION:**

No. of weeks per Semester : 15 Weeks

| Subject                                                            | Instructions   |                     | Examination            |                      |       |          |
|--------------------------------------------------------------------|----------------|---------------------|------------------------|----------------------|-------|----------|
|                                                                    | Hours/<br>Week | Hours /<br>Semester | Marks                  |                      |       | Duration |
| <b>REFRIGERATION<br/>AND AIR<br/>CONDITIONING<br/>APPLICATIONS</b> | 5              | 75                  | Internal<br>Assessment | Board<br>Examination | Total |          |
|                                                                    |                |                     | 25                     | 75                   | 100   | 3 Hrs    |

**TOPICS AND ALLOCATION OF MARKS**

| Sl.No        | Topic                                                               | Time(Hrs.) |
|--------------|---------------------------------------------------------------------|------------|
| 1.           | Refrigeration Applications & Food preservation                      | 14         |
| 2.           | Food Processing & Preservation By Refrigeration                     | 14         |
| 3.           | Commercial refrigerators, cooling load and blood bank refrigerators | 14         |
| 4.           | Commercial Air conditioning                                         | 13         |
| 5.           | Transport Air Conditioning                                          | 13         |
| 6.           | TEST & REVISION                                                     | 07         |
| <b>Total</b> |                                                                     | <b>75</b>  |

**Rationale :**

Application of refrigeration in food preservations and processing, commercial refrigeration applications. To study industrial air conditioning and transport air conditioning.

**Objectives :**

- ❖ To understand applications of refrigeration in food preservation
- ❖ To know about application of refrigeration in food processing

- ❖ To acquire knowledge about commercial refrigerators such as reach in cooler, walk in coolers, display cases and blood bank refrigeration and preservation of viruses and tissues.
- ❖ To learn industrial applications of air conditioning in heat treatment of metals, hospital air conditioning and textile industry
- ❖ To understand basic concept of transport air conditioning in automobile, railways, ships and trucks, trailers.

### **32472 - REFRIGERATION AND AIR CONDITIONING APPLICATIONS** **DETAILED SYLLABUS**

#### **CONTENTS**

| <b>UNIT</b> | <b>NAME OF TOPICS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>Hours</b> |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| I           | <b>Refrigeration Applications &amp; Food preservation</b><br>Refrigeration Applications Classification of refrigeration applications – Domestic refrigeration, commercial refrigeration, Industrial refrigeration, Marine refrigeration and transportation refrigeration.<br>Food preservation<br>Objectives of food preservation – preservation in edible condition, preserving quality –appearance, odour, taste and vitamin content.<br>Factors contributing to food spoilage – causes of food spoiling – enzymes and micro organisms – bacteria, yeasts and molds control of spoilage agents.<br>Refrigerated storage – short term or temporary storage, long term storage & frozen storage – storage temperature, humidity and air motion. Freezing and frozen storage – freezing methods – immersion, indirect contact and air blast, quick freezing versus sharp freezing-freeze drying.                                                                                                  | 14           |
| II          | <b>Food Processing &amp; Preservation by Refrigeration</b><br>Candy – manufacture and storage conditions, Beverage processing – beer, wines and carbonated drinks - refrigeration in food preservation, processing control and storage. meat products – chilling, processing & storage conditions poultry products – chilling, freezing & storage conditions. Fishery products –processing, preservation and transportation of fresh and frozen fish and their products – icing of fish individual quick freezing, contact plate freezers, air – blast freezers and immersion freezers.<br><br>Fruits and vegetables – storage requirements of common fruits & vegetables, controlled atmosphere storage suitability of freezing and dehydro-freezing – fruits ripening.<br><br>Dairy products – pre cooling for separation and blending, pasteurization process, equipments used. Butter separation & storage - Ice-cream manufacture – process, processing temperature and storage conditions. | 14           |

|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |    |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| III | <p><b>Commercial refrigerators, cooling load and blood bank refrigerators</b></p> <p>(A) Commercial refrigerators:<br/>Commercial refrigerators – construction and working of reach in refrigerators, walk in coolers and display cases.</p> <p>(B) Cooling load and freezing load calculations for design of freezer and cold storages: Cooling load calculation – common sources of heat load – wall gain load (Transmission load), product load – sensible latent heat and respiration load, air change and infiltration load, miscellaneous load due to electric motors, lighting, people working inside storage rooms etc – equipment running time, chilling rate factor, use of safety factor, insulation of cold storage walls. Refrigeration load in freezers and freezing time calculations. Problems – problems on cooling load and freezing load calculations. Use of charts and tables allowed in Board Examinations.</p> <p>(C) Blood Bank Refrigeration and Preservation of tissue and virus:<br/>Blood preservation – storage temperature and equipments. preservation of tissues – storage temperature<br/>Preservation of virus – storage temperature and applications. Effects of refrigeration on blood, tissues and virus.</p> | 14 |
| IV  | <p><b>Commercial Air Conditioning</b></p> <p>(A) Manufacture and Heat treatment of metals:<br/>Heat treatment of metals- effect of humidity and temperature control – increased hardness, dimensional stability of tools and gauges, elimination of grinding cracks, cutter tool life, high magnetic properties, workability, casting with frozen mercury patterns, fittings.</p> <p>(B) Hospital Air conditioning:<br/>Necessity for hospital air conditioning, requirements of air conditioning system for different departments – diagnostic and treatment department, nursery department, surgical department, emergency department, service department, recovery rooms.</p> <p>(C) Air conditioning for textile industry- Requirements and equipments used.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 13 |
| V   | <p><b>Transport Air conditioning</b></p> <p>(A) Automobile Air conditioning:<br/>Automobile air conditioning - source of power – factors affecting cooling load – out door conditions, air leakage into passenger space, number of occupants, sun load, fresh air, variation of cooling load with automobile speed. Basic components of automobile air conditioning – compressor, magnetic clutch, condenser, receiver and drier, expansion valve, evaporator, suction throttle valve, air distribution in passenger cars, car insulation, capacity and weight of air conditioning system. Design considerations in bus air conditioning – capacity and weight of air conditioner.</p> <p>(B) Railway air conditioning: Location of different air conditioning equipments, types of power system used in axle driven system, engine driven compressor system electro mechanical system. Compression cooling system and air distribution.</p>                                                                                                                                                                                                                                                                                                       | 13 |

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|  | <p>(C) Marine Air conditioning: Design requirements, ambient and indoor conditions. Special problems in ship air conditioning – air circulation, air conditioning machinery, safety of ships, ventilation requirements, air distribution methods. Air conditioning system used for ships – single zonal central system, multi zone central system, terminal reheat system. Control of design conditions – volume control reheat control, air mixture control.</p> <p>(D) Refrigerated trucks and trailers:<br/>         Temperatures maintained for cold foods and frozen foods, Types of refrigeration system – product sub cooling, using water ice, water ice in bunker with forced air circulation, using dry ice Using liquid nitrogen or Carbondi-oxide spray, Eutectic plates with station charging, eutectic plates with vehicle-mounted condensing unit, mechanical refrigeration with independent engine or electric motor, mechanical refrigeration deriving power from vehicle engine or transmission.</p> |  |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|

**Text Book:**

1. Refrigeration and Air-conditioning by Arora and Domkundwar Danpat Rai & Sons Publications

**Reference Books:**

1. ISHRAE Handbook on HVAC application



DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)

M SCHEME  
2015 -2016 onwards

III YEAR  
V SEMESTER

**32454 - R & A/C MACHINES**

CURRICULUM DEVELOPMENT CENTRE

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

**DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)  
M-SCHEME**

(to be Implemented for the students Admitted from the Year 2015-2016 onwards)

Course Name : Diploma in Mechanical Engineering(R&A/C)

Subject Code : 32454

Semester : V Semester

Subject Title : **R & A/C MACHINES**

**TEACHING AND SCHEME OF EXAMINATIONS :**

No. of weeks per Semester : 15 Weeks

| Subject                     | Instructions |                  | Examination         |                   |       |          |
|-----------------------------|--------------|------------------|---------------------|-------------------|-------|----------|
|                             | Hours / Week | Hours / Semester | Marks               |                   |       | Duration |
| <b>R &amp; A/C MACHINES</b> | 5            | 75               | Internal Assessment | Board Examination | Total |          |
|                             |              |                  | 25                  | 75                | 100   | 3 Hrs    |

**TOPICS AND ALLOCATION OF HOURS**

| Sl.No        | Topic                                | Time(Hrs.) |
|--------------|--------------------------------------|------------|
| I            | Compressor                           | 14         |
| II           | Condensers & Cooling Towers          | 14         |
| III          | Evaporators & Expansion Devices      | 14         |
| IV           | Fans, Blowers & Wiring diagrams      | 13         |
| V            | Filters, Humidifiers & Dehumidifiers | 13         |
|              | TEST & REVISION                      | 07         |
| <b>Total</b> |                                      | <b>75</b>  |

**Rationale** :To learn about basic functions of different component of machines used in Refrigeration and Air conditioning with design considerations.

**Objectives :**

- ❖ To learn about functions, types, working, design consideration of Compressor
- ❖ To learn about functions, types, working, design consideration of Condenser and cooling towers
- ❖ To learn about functions, types, working, design consideration of Evaporator and expansion devices

- ❖ To learn about functions, types, working, design consideration of fans and blowers and learn about wiring diagram of R & A/C
- ❖ To learn about functions, types, working of filters, humidifiers and dehumidifiers.

## 32472 - R & A/C MACHINES DETAILED SYLLABUS

### CONTENTS

| UNIT | NAME OF TOPICS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Hours |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| I    | <p><b>Compressor</b></p> <p>Main functions of a compressor, types of compressors in common use. Reciprocating compressor –capacity range, open types reciprocating compressor - volumetric efficiency, clearance volumetric efficiency, power required to run the compressor, construction &amp; working of single acting and single stage reciprocating compressor- controls</p> <p>Hermetically sealed compressors – construction, working advantages over open type - Capacity controls for open-type reciprocating compressors – suction valve lift control, cylinder head by pass, speed control, multiple units, hot gas by pass system.</p> <p>Rotary compressors – types, Roller type, Vane type, construction and working, advantages of rotary compressors. Centrifugal compressors – construction &amp; working, multistage systems, three stage system with flash chamber, representation of three stage system in p-h diagram, capacity control of centrifugal compressors, advantages of centrifugal compressors.</p> <p>Design considerations of centrifugal compressors – Static head, velocity head total head developed by single impeller, tip velocity, discharge pressure and tip velocity, multi stage centrifugal compressors, suitable refrigerants, applications. Screw compressors – operation, construction, capacity control, advantages. Scroll compressors – construction, working, advantages- variable frequency drive compressors - No problems and no derivations</p> <p>Lubricants- desirable properties – charging of lubricants – Refrigerant &amp; Lubricant miscibility</p> | 14    |
| II   | <p><b>Condensers &amp; Cooling Towers</b></p> <p>(A) Condenser – functions of condensers, condensing or cooling mediums. Types of condensers – air-cooled, water – cooled, evaporative condensers. Fins – types - Condenser load – heat absorbed and heat of compression, heat rejection, sensible heat rejection or de-superheating, latent heat rejection, sub cooling – representation in p-h chart, condenser load calculation using Heat rejection factor (HRF) and compressor capacity, use of THR, total heat rejection specified by compressor manufactures, fundamental heat</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 14    |

|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |    |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
|     | <p>transfer equation of condenser capacity, quantity and temperature rise of condensing medium, Temperature distribution or profile, Liquid receiver</p> <p>Air cooled condensers – relationship between face area, air quantity and air velocity, effect of air velocity on heat transfer co-efficient and pressure drop, power requirements of fan or blower, range of air velocities in commercial condensers, construction &amp; working of natural convection air –cooled condensers, types of forced convection air-cooled condensers, Chasis mounted and remote air – cooled condensers, Water – cooled condensers – waste water system, recirculated water system, water circuit connected for series flow, water circuit connected for parallel flow, fouling rates, factors influencing fouling rates. Construction working &amp; applications of double tube or tube- in-tube, shell-and –coil, and shell-and-tube coater – cooled condensers. Simple problems – involving calculation of condenser capacity, quantity of air, quantity of water, velocity of cooling medium, temp. rise of cooling medium- installation procedure - Evaporative condenser – cooling mediums, construction and working.</p> <p>(B) Cooling towers</p> <p>Cooling towers – functions of a cooling tower, basic principle involved in cooling of water, factors affecting rate of evaporation of water in a cooling tower, minimum possible temperature to which water can be cooled in a cooling tower, tower range, approach, efficiency, condenser by pass – relationship between tower flow rate, tower range, condenser flow rate and temp. rise in condenser. Types of cooling towers – construction &amp; working of Natural draft of atmospheric spray tower, types of Mechanical draft cooling towers – construction, efficiency and working of forced, draft cooling tower &amp; induced draft cooling tower. Simple problems in range, approach &amp; efficiency.</p> |    |
| III | <p><b>Evaporators &amp; Expansion Devices</b></p> <p>(A) Evaporators</p> <p>Evaporators – Main functions. Types of construction – bane –tube, plate, surface, advantage of fins, finned, internal fin and external fins, criteria for selecting internal fins, external fins or bane tubes, plate type evaporators, brazed plate evaporator</p> <p>Liquid Chiller tube Construction &amp; working of shell and tube evaporator, shell and coil evaporator, tube-in-tube flooded evaporator. Natural convection evaporators and forced convection evaporators, direct expansion evaporators – simple problems - accumulators</p> <p>(B) Expansion devices</p> <p>Functions - dry hand expansion valve expansion evaporator controls – Automatic Expansion valve, Thermostatic expansion valve, electronic expansion valve – construction, pressures equilibrium method of control working and operating characteristics – when cooling load increases, when cooling load decreases, when compressor is switched on and when compressor is switched off. TEV with external quality – necessity of TEV with external equalizer, construction and working.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 14 |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |    |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
|    | Capillary tube – construction, working and operating characteristic. Flooded evaporator control – Construction and working of Low prefloat control and high pressure float control valve.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |    |
| IV | <b>FANS, BLOWERS &amp; WIRING DIAGRAMS</b><br>(A) Fans & Flowmeters - function of fans & blowers, fan laws- types of fans centrifugal fans, three forms of blade or vane designs<br>Fan arrangements – fans in series, fans in parallel Fan – duct system interaction – system resistance curve -superimposed, point of operation, fan selection. No problems & no derivations - Wiring diagrams – types of wiring diagram – RSIR, CSIR, CSCR, PSC. – system safety controls – pressure, temperature controls – solenoid valve                                                                                                                                                                                                                                                                                                        | 13 |
| V  | <b>FILTERS, HUMIDIFIERS &amp; DEHUMIDIFIERS</b><br>(A) Filters : Function of filters, impurities in air – dust, fumes, smoke, fogs, pollens, bacteria. Effects of dust on health. Methods of cleaning air – air filtration, sterilization, ionization odour suppression. Air-filters – Dry filters, viscous filters, wet filters, electric filters, centrifugal dust collectors.<br><br>(B) Humidifiers : by steam injection – steam injection type and electric steam generator. By Atomizing the coater – Atomization type, impact type, hydraulic separation type, mechanical separation. By Evaporating the water – pan & coil type, Heated Water type heated air type By air washing – spray type air washer humidifier.<br><br>(C) Dehumidifiers : Dehumidification – by reducing air temp. below DPT, spray type dehumidifier. | 13 |

**Text Book:**

1. Refrigeration and Air-conditioning by Arora & Domkundwar Danpat Rai & Sons Publications

**Reference Books:**

1. Refrigeration and Air-conditioning by C.P.Arora



**DIRECTORATE OF TECHNICAL EDUCATION**  
**DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)**

**M SCHEME**  
**2015 -2016 onwards**

**III YEAR**  
**V SEMESTER**

**32455 - REFRIGERATION PRACTICAL**

**CURRICULUM DEVELOPMENT CENTRE**

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

**DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)  
M-SCHEME**

(to be Implemented for the students Admitted from the Year 2015-2016 onwards)

Course Name : Diploma in Mechanical Engineering(R&A/C)

Subject Code : 32455

Semester : V Semester

Subject Title : **REFRIGERATION PRACTICAL**

**TEACHING AND SCHEME OF EXAMINATIONS :**

No. of weeks per Semester : 15 Weeks

| Subject                    | Instructions  |                     | Examination            |                      |       |          |
|----------------------------|---------------|---------------------|------------------------|----------------------|-------|----------|
|                            | Hours<br>Week | Hours /<br>Semester | Marks                  |                      |       | Duration |
| REFRIGERATION<br>PRACTICAL | 4             | 60                  | Internal<br>Assessment | Board<br>Examination | Total |          |
|                            |               |                     | 25                     | 75                   | 100   |          |

**Note: All the experiments should be conducted. Examination will be conducted based on one Experiment from each Part.**

**LIST OF EXPERIMENTS**

**Part A**

1. (a) Cutting operation on copper tube  
(b) Bending and straightening of copper tube using spring bender
2. Flaring operation on a copper tube
3. (a) Pinching operation on a copper tube  
(b) Swaging operation on copper tube
4. Brazing of copper tube
5. U bending operation on copper tube
6. Removal of refrigerant from a sealed system
7. Study of service valves and installation of gauge manifold set in open type system rig.
8. Determination of COP of medium and low temperature systems

**Part B**

1. To find percentage running time of refrigerator with different setting of thermostat
2. To determine refrigeration effect, heat of compression and capacity of a sealed system

3. To determine capacity and actual COP of a refrigeration unit
4. To find common, starting and running terminals of a hermetic compressor
5. Wiring, starting and running of refrigeration unit with RSIR starting circuit
6. Wiring, starting and running of a refrigeration unit with CSIR starting circuit
7. Charging refrigerant in the system

### **BOARD EXAMINATION - DETAILED ALLOCATION**

**Note:** All the experiments in both sections have to be completed. Two experiments will be given for examination by selecting one experiments in each section.

All the experiments should be given in the question paper and students are allowed to select by a lot.

Record note book should be submitted during examination.

|                 |          |
|-----------------|----------|
| Question PART A | 30 marks |
| Question PART B | 40 marks |
| Viva voce       | 5 marks  |
| Total           | 75 marks |

### **LIST OF EQUIPMENTS**

| <b>S.no</b> | <b>Equipments</b>                                                                                               |
|-------------|-----------------------------------------------------------------------------------------------------------------|
| 1           | Computer based Refrigeration test rig (Software and Hardware Set up) with 1/3 HP Hermetically sealed Compressor |
| 2           | Refrigeration test rig with electronic thermostat and timer facility                                            |
| 3           | Hermetically sealed Compressor with multimeter or tongue tester                                                 |
| 4           | Hermetically sealed Compressor with starting Capacitor ,running Capacitor and wiring Kit                        |
| 5           | Hermetically sealed Compressor with running Capacitor and wiring Kit                                            |
| 6           | Refrigeration test rig                                                                                          |



DIRECTORATE OF TECHNICAL EDUCATION  
DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)

M SCHEME  
2015 -2016 onwards

III YEAR  
V SEMESTER

ELECTIVE PRACTICAL  
**32473 - CRYOGENIC ENGINEERING PRACTICAL**

CURRICULUM DEVELOPMENT CENTRE

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

**DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)**

**M-SCHEME**

**ELECTIVE**

(to be Implemented for the students Admitted from the Year 2015-2016 onwards)

Course Name : Diploma in Mechanical Engineering(R&A/C)

Subject Code : 32473

Semester : V Semester

Subject Title : **CRYOGENIC ENGINEERING PRACTICAL**

**TEACHING AND SCHEME OF EXAMINATIONS :**

No. of weeks per Semester : 15 Weeks

| Subject                                        | Instructions   |                     | Examination            |                      |       |          |
|------------------------------------------------|----------------|---------------------|------------------------|----------------------|-------|----------|
|                                                | Hours/<br>Week | Hours /<br>Semester | Marks                  |                      |       | Duration |
| <b>CRYOGENIC<br/>ENGINEERING<br/>PRACTICAL</b> | 4              | 60                  | Internal<br>Assessment | Board<br>Examination | Total |          |
|                                                |                |                     | 25                     | 75                   | 100   | 3 Hrs    |

**LIST OF EXPERIMENTS**

**PART A:**

1. Gas Liquefaction study
2. Liquefaction of Neon
3. Liquefaction of Hydrogen
4. Liquefaction of Helium
5. Magnetic cooling systems

**PART B:**

1. By using Linde double columns system separation of
  - a. Argon
  - b. Neon
  - c. Hydrogen
2. Increase the tool life by cryogenics
3. Measurement of cryogenic Temperature
4. Measurement of cryogenic Pressure
5. Measurement of Liquid level (cryogenic)

## BOARD EXAMINATION - DETAILED ALLOCATION

**Note:** All the experiments in both sections have to be completed. Two experiments will be given for examination by selecting one experiments in each section.

All the experiments should be given in the question paper and students are allowed to select by a lot.

Record note book should be submitted during examination.

### Scheme of Examination

Question Part -A : 35 marks

Question Part -B : 35 marks

Viva voce: 5 marks

Total : 75 marks



DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)

M SCHEME  
2015 -2016 onwards

III YEAR  
V SEMESTER

ELECTIVE PRACTICAL  
**32474 - R&A/C MACHINES PRACTICAL**

CURRICULUM DEVELOPMENT CENTRE

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

**DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)**

**M-SCHEME**

**ELECTIVE**

(to be Implemented for the students Admitted from the Year 2015-2016 onwards)

Course Name : Diploma in Mechanical Engineering(R&A/C)

Subject Code : 32474

Semester : V Semester

Subject Title : **R & A/C MACHINES PRACTICAL**

**TEACHING AND SCHEME OF EXAMINATIONS :**

No. of weeks per Semester : 15 Weeks

| Subject                    | Instructions |                  | Examination         |                   |       |          |
|----------------------------|--------------|------------------|---------------------|-------------------|-------|----------|
|                            | Hours / Week | Hours / Semester | Marks               |                   |       | Duration |
| R & A/C MACHINES PRACTICAL | 4            | 60               | Internal Assessment | Board Examination | Total |          |
|                            |              |                  | 25                  | 75                | 100   | 3 Hrs    |

**LIST OF EXPERIMENTS**

**PART A:**

1. To test pumping capacity of sealed compressor
2. To determine efficiency of a fan or blower
3. To determine the capacity of cooling coil
4. To set and adjust low pressure cut out
5. To set and adjust high pressure cut out
6. To set and adjust AEV

**PART B:**

1. To set and adjust TEV
2. To determine volumetric efficiency of open type compressor.
3. To test capacitor and potential relay
4. To set and adjust thermostat
5. To test the working of OLP and selector switch
6. To measure bore, stroke and clearance volume of open type compressor and calculate Clearance factor.

## BOARD EXAMINATION - DETAILED ALLOCATION

**Note:** All the experiments have to be completed. Two experiments will be given for examination by selecting one experiments in each PART.

All the experiments should be given in the question paper and students are allowed to select by a lot.

Record note book should be submitted during examination.

### Scheme of Examination

Question PART- A : 35 marks

Question PART- B : 35 marks

Viva voce: 5 marks

Total : 75 marks

### LIST OF EQUIPMENTS

| Sno | Equipments                                                           |
|-----|----------------------------------------------------------------------|
| 1   | Sealed type Compressor with Gauge manifold (Pressure gauge)          |
| 2   | Test rig of a fan or blower                                          |
| 3   | Air conditioning test rig                                            |
| 4   | Air conditioning test rig with provision for cut off                 |
| 5   | Refrigeration test rig with provision for AEV, TEV                   |
| 6   | Air Compressor test rig- 1 HP Compressor                             |
| 7   | Potential relay capacitor, sealed type Compressor                    |
| 8   | Refrigeration test rig with electronic thermostat and timer facility |
| 9   | Refrigeration test rig with OLP and selector switch                  |
| 10  | Bore dial Indicator                                                  |



DIRECTORATE OF TECHNICAL EDUCATION  
DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)

M SCHEME  
2015 -2016 onwards

III YEAR  
V SEMESTER

**30002 – LIFE AND EMPLOYABILITY SKILL PRACTICAL  
[COMMON TO ALL ENGINEERING COURSE]**

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            |                      |       |          |
|-------------------------------|----------------|--------------------|------------------------|----------------------|-------|----------|
|                               | Hours/<br>Week | Hours/<br>Semester | Marks                  |                      |       | Duration |
|                               |                |                    | Internal<br>assessment | Board<br>Examination | Total |          |
| 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            | <b>Part – A</b><br>Communication                                                                                                            | 30           |
| 2            | <b>Part – B</b><br>Entrepreneurship, Project Preparation, Productivity, Occupational Safety, Health, Hazard, Quality Tools & Labour Welfare | 20           |
| 3            | <b>Part – C</b><br>Environment, Global Warming, Pollution                                                                                   | 10           |
| <b>TOTAL</b> |                                                                                                                                             | <b>60</b>    |

### RATIONALE

Against the backdrop of the needs of the Industries, as well 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--<br>self- introduction/another<br>higher official in company<br>– describe/explain product<br>– frame questions based on<br>patterns<br>– make sentences based on<br>patterns | 30    |
| II   | Entrepreneurship, Project Preparation, Marketing Analysis, Support & Procurement                                     | -- prepare an outline of a<br>project to obtain loan from<br>bank in becoming an<br>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 –<br>answering questions<br>-- fill in blanks the exact words<br>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 | 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)

|                                                                 |                 |
|-----------------------------------------------------------------|-----------------|
| <b>Note down and present in the Record Note on any 5 topics</b> | <b>10 Marks</b> |
| <b>Other activities recorded in the Record note</b>             | <b>10 Marks</b> |
| <b>Attendance</b>                                               | <b>05 Marks</b> |

|                       |                 |
|-----------------------|-----------------|
| <b>INTERNAL MARKS</b> | <b>25 MARKS</b> |
|-----------------------|-----------------|

|                                          |                 |
|------------------------------------------|-----------------|
| <b>EXTERNAL MARKS AT END EXAMINATION</b> | <b>75 MARKS</b> |
|------------------------------------------|-----------------|

## 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

## 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 MECHANICAL ENGINEERING(R&A/C)

M SCHEME  
2015 -2016 onwards

III YEAR  
VI SEMESTER

**32061 – INDUSTRIAL ENGINEERING AND MANAGEMENT**

CURRICULUM DEVELOPMENT CENTRE

## M-SCHEME

(Implemented from the Academic year 2015-2016 onwards)

**Course Name** : DIPLOMA IN MECHANICAL ENGINEERING(R&AC)  
**Course Code** : 1221  
**Subject Code** : 32061  
**Semester** : VI  
**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         |
|          | <b>TOTAL</b>                                                 | <b>90</b> |

## **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**

| <b>UNIT</b> | <b>NAME OF THE TOPIC</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>HOURS</b> |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>I</b>    | <b>PLANT ENGINEERING AND PLANT SAFETY</b><br><br><b>Plant Engineering :</b> 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.<br><br><b>Plant Safety:</b> 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 | <b>17</b>    |

|            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |           |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|            | provisions related to health, welfare and safety.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |           |
| <b>II</b>  | <p><b>WORK STUDY, METHOD STUDY AND WORK MEASUREMENT</b></p> <p><b>Work Study:</b> Productivity – Standard of living – method of improving productivity</p> <p>– Objectives – Importance of good working conditions.</p> <p><b>Method Study:</b> 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.</p> <p><b>Work Measurement:</b> 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).</p>                                                                                                                       | <b>17</b> |
| <b>III</b> | <p><b>PRODUCTION PLANNING AND QUALITY CONTROL</b></p> <p><b>Production Planning and Control:</b> 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.</p> <p><b>Quality Control:</b> 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</p> | <b>17</b> |

|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |           |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|           | organization.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |           |
| <b>IV</b> | <p><b>PRINCIPLES, PERSONNEL MANAGEMENT AND ORGANIZATIOAL BEHAVIOR:</b></p> <p><b>Principles of Management:</b> 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.</p> <p><b>Personnel Management:</b> 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.</p> <p><b>Organizational behavior:</b> 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.</p> | <b>16</b> |
| <b>V</b>  | <p><b>FINANCIAL AND MATERIAL MANAGEMENT</b></p> <p><b>Financial Management:</b> 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 –</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>16</b> |

|  |                                                                                                                                                                                                                                                                                                                         |  |
|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|  | Problems.<br><b>Material management:</b> 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 Edition. 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, 10<sup>th</sup> 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, Prentice Hall of India Pvt. Ltd. New Delhi. Latest.



DIRECTORATE OF TECHNICAL EDUCATION  
DIPLOMA IN MECHANICAL ENGINEERING(R&AC)

M SCHEME  
2015 -2016 onwards

III YEAR  
VI SEMESTER

**32062 – COMPUTER AIDED DESIGN AND  
MANUFACTURING**

CURRICULUM DEVELOPMENT CENTRE

## M-SCHEME

(Implements from the Academic year 2015-2016 onwards)

**Course Name** : DIPLOMA IN MECHANICAL ENGINEERING(R&AC)

**Course Code** : 1221

**Subject Code** : 32062

**Semester** : VI

**Subject Title** : COMPUTER AIDED DESIGN AND MANUFACTURING

### TEACHING AND SCHEME OF EXAMINATIONS:

No. of weeks per semester: 15 Weeks

| Subject                                       | Instructions    |                     | Examination            |                      |       |          |
|-----------------------------------------------|-----------------|---------------------|------------------------|----------------------|-------|----------|
| Computer Aided<br>Design and<br>Manufacturing | Hours /<br>Week | Hours /<br>Semester | Marks                  |                      |       | Duration |
|                                               | 5               | 75                  | Internal<br>Assessment | Board<br>Examination | Total | 3 Hrs    |
|                                               |                 |                     | 25                     | 75                   | 100   |          |

### Topics and Allocation of Hours:

| Unit | Topics                                                                                             | Hours     |
|------|----------------------------------------------------------------------------------------------------|-----------|
| I    | COMPUTER AIDED DESIGN                                                                              | 14        |
| II   | COMPUTER AIDED MANUFACTURING                                                                       | 14        |
| III  | CNC PROGRAMMING, RAPID PROTOTYPING                                                                 | 14        |
| IV   | COMPUTER INTEGRATED MANUFACTURING, FLEXIBLE MANUFACTURING SYSTEMS, AUTOMATIC GUIDED VEHICLE, ROBOT | 13        |
| V    | CONCURRENT ENGINEERING, QUALITY FUNCTION DEPLOYMENT, PRODUCT DEVELOPMENT CYCLE, AUGMENTED REALITY. | 13        |
|      | REVISION AND TEST                                                                                  | 7         |
|      | <b>Total</b>                                                                                       | <b>75</b> |

## 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 CNC programming techniques are included.

## 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.
- Understand the principle of latest manufacturing machines like RPT.
- Acquire the knowledge in the material handling equipment and robot.
- Understand the Computer Integrated Manufacturing and FMS.
- Study of Concurrent Engineering and its tools and Augmented Reality.

## COMPUTER AIDED DESIGN AND MANUFACTURING DETAILED SYLLABUS

### Contents: Theory

| Unit | Name of the Topic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Hours |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| I    | <b>COMPUTER AIDED DESIGN</b><br><b>Computer Aided Design:</b> Introduction – definition – Shigley's design process – Ohsguga Model - CAD activities – benefits of CAD - CAD software packages.<br><b>Transformations:</b> 2D & 3D transformations – translation, scaling, rotation and concatenation.<br><b>Geometric modelling:</b> Techniques - Wire frame modelling – applications – advantages and disadvantages. Surface modelling – types of surfaces – applications – advantages and disadvantages – Solid modelling – entities – advantages and disadvantages – Boolean | 14    |

|            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |           |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|            | <p>operations - Boundary representation – Constructive Solid Geometry – Comparison.</p> <p><b>Graphics standard:</b> Definition – Need - GKS – OpenGL - IGES – DXF.</p> <p><b>Finite Element Analysis:</b> Introduction – Development - Basic steps – Advantage.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |           |
| <b>II</b>  | <p><b>COMPUTER AIDED MANUFACTURING</b></p> <p><b>Computer Aided Manufacturing:</b> Introduction - Definition – functions of CAM – benefits of CAM.</p> <p><b>Group technology:</b> Part families - Parts classification and coding - coding structure – Optiz system, MICLASS system and CODE System.</p> <p><b>Process Planning:</b> Introduction – Computer Assisted Process Planning (CAPP) – Types of CAPP - Variant type, Generative type – advantages of CAPP.</p> <p><b>Production Planning and Control (PPC):</b> Definition – objectives - Computer Integrated Production management system – Master Production Schedule (MPS) – Capacity Planning – Materials Requirement Planning (MRP) – Manufacturing Resources Planning (MRP-II) – Shop Floor Control system (SFC) - Just In Time manufacturing philosophy (JIT) - Introduction to Enterprise Resources Planning (ERP).</p> | <b>14</b> |
| <b>III</b> | <p><b>CNC PROGRAMMING, RAPID PROTOTYPING</b></p> <p><b>CNC PART PROGRAMMING:</b> Manual part programming - coordinate system – Datum points: machine zero, work zero, tool zero - reference points - NC dimensioning – G codes and M codes – linear interpolation and circular interpolation - CNC program procedure - sub-program – canned cycles - stock removal – thread cutting – mirroring – drilling cycle – pocketing.</p> <p><b>Rapid prototyping:</b> Classification – subtractive – additive – advantages and applications - materials. Types - Stereo lithography (STL) – Fused deposition model (FDM) – Selective laser sintering (SLS) - three dimensional printing (3D) – Rapid tooling.</p>                                                                                                                                                                                | <b>14</b> |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |    |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| IV | <p><b>COMPUTER INTEGRATED MANUFACTURING, FLEXIBLE MANUFACTURING SYSTEMS, AUTOMATIC GUIDED VEHICLE, ROBOT</b></p> <p><b>CIM:</b> Introduction of CIM – concept of CIM - evolution of CIM – CIM wheel – Benefits – integrated CAD/CAM.</p> <p><b>FMS:</b> Introduction – FMS components – FMS layouts – Types of FMS: Flexible Manufacturing Cell (FMC) – Flexible Turning Cell (FTC) – Flexible Transfer Line (FTL) – Flexible Machining System (FMS) – benefits of FMS - introduction to intelligent manufacturing system.</p> <p><b>AGV:</b> Introduction – AGV - working principle – types – benefits.</p> <p><b>ROBOT:</b> Definition – robot configurations – basic robot motion – robot programming method – robotic sensors – end effectors – mechanical grippers – vacuum grippers - Industrial applications of Robot: Characteristics - material transfer and loading – welding - spray coating - assembly and inspection.</p> | 13 |
| V  | <p><b>CONCURRENT ENGINEERING, QUALITY FUNCTION DEPLOYMENT, PRODUCT DEVELOPMENT CYCLE, AUGMENTED REALITY.</b></p> <p><b>Concurrent Engineering:</b> Definition – Sequential Vs Concurrent engineering – need of CE – benefits of CE.</p> <p><b>Quality Function Deployment (QFD):</b> Definition – House of Quality (HOQ) – advantages – disadvantages. Steps in Failure Modes and Effects Analysis (FMEA) – Value Engineering (VE) – types of values – identification of poor value areas – techniques – benefits. Guide lines of Design for Manufacture and Assembly (DFMA).</p> <p><b>Product Development Cycle:</b> Product Life Cycle - New product development processes.</p> <p><b>Augmented Reality (AR)</b> – Introduction - concept – Applications.</p>                                                                                                                                                                       | 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.

**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 MECHANICAL ENGINEERING(R&A/C)

M SCHEME  
2015 -2016 onwards

III YEAR  
VI SEMESTER

ELECTIVE THEORY  
**32481 - DESIGN OF R&A/C**

CURRICULUM DEVELOPMENT CENTRE

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

**DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)**

**M-SCHEME**

**ELECTIVE**

(to be Implemented for the students Admitted from the Year 2015-2016 onwards)

Course Name : Diploma in Mechanical Engineering(R&A/C)

Subject Code : 32481

Semester : VI Semester

Subject Title : **DESIGN OF R & A/C**

**TEACHING AND SCHEME OF EXAMINATIONS :**

No. of weeks per Semester : 15 Weeks

| Subject           | Instructions |                  | Examination         |                   |       |          |
|-------------------|--------------|------------------|---------------------|-------------------|-------|----------|
|                   | Hours / Week | Hours / Semester | Marks               |                   |       | Duration |
| DESIGN OF R & A/C | 5            | 75               | Internal Assessment | Board Examination | Total |          |
|                   |              |                  | 25                  | 75                | 100   |          |

**TOPICS AND ALLOCATION OF HOURS**

| Sl.No        | Topic                                       | Time(Hrs.) |
|--------------|---------------------------------------------|------------|
| 1.           | Conduction                                  | 14         |
| 2.           | Convection                                  | 14         |
| 3.           | Radiation and Heat Exchanger                | 14         |
| 4.           | Insulation, Components Selection and Design | 13         |
| 5.           | Duct Design                                 | 13         |
| 6.           | TEST & REVISION                             | 07         |
| <b>Total</b> |                                             | <b>75</b>  |

**Rationale :**

To design and selection of machines used in refrigeration and air conditioning as per specific requirements.

**Objectives :**

- ❖ To understand the basic concept of conduction, heat transfer through slabs and pipes
- ❖ To understand the basic concept of convection, heat transfer in laminar and turbulent flow
- ❖ To understand radiation, heat exchanger and working heat exchanger
- ❖ To learn about system components, selection and design of compressors and condensers
- ❖ To learn about selection of cooling towers, expansion devices and design of ducts

**32481 - DESIGN OF R & A/C  
DETAILED SYLLABUS**

**CONTENTS**

| UNIT | NAME OF TOPICS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Hours |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| I    | <b>CONDUCTION</b><br>Introduction to heat transfer – Modes of heat transfer – Fourier's Law of conduction – Definition for thermal conductivity – Definition for thermal resistance – heat flux definition – conduction through plain walls and composite walls, simple and composite pipes - lumped system analysis – simple problems - no derivations.<br><br>Lumped system analysis - fins- types of fins - efficiency and effectiveness of fins - only theory-no derivation – no problems                                                                                                                                                                                                                               | 14    |
| II   | <b>Convection</b><br>Convection - convective heat transfer coefficient - types of convection natural convection - forced convection-definition only-Rayleigh number-Grashoff number - only definition-problems on natural convection heat transfer and problems on forced convection heat transfer (both laminar flow & turbulent flow) only on flat plate. Newton's law of convection - Reynolds number - Prandtl number - Nusselt number (definition only) - Laminar flow - Turbulent flow - (definition only) simple problems to find heat transfer using forced convection – Natural convection (definition) - Simple problems to find heat transfer in vertical pipes and vertical plates- internal and external flow. | 14    |
| III  | <b>Radiation and Heat Exchanger</b><br>(A) RADIATION : Radiation – Reflection, Absorption & transmittance of Radiation – Black body concept – Grey body concept – No problem – No derivation.<br>(B) HEAT EXCHANGER : Introduction – Mean temperature difference – parallel flow – counter flow – cross flow heat exchanger, LMTD & NTU methods of derivation for counter flow - simple problems on Heat                                                                                                                                                                                                                                                                                                                    | 14    |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |    |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
|    | exchanger – Temperature distribution in condenser & evaporator – simple problems                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |    |
| IV | <b>Insulation, Components Selection and Design</b><br>Selection of compressor – condenser –Expansion valve – Evaporator – Design step for reciprocating compressor – Design steps for evaporator – Design steps for water cooled condenser – Design steps for cooling tower according to the applications - No Problems – No derivations. Insulation – design – types – need – simple problems on thickness                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 14 |
| V  | <b>Duct Design</b><br>Duct layouts – perimeter systems, extended plenum system, arrangement for commercial and residential applications -classification of duct system – single duct system, dual duct systems – dual duct system combined with induction system, return duct systems.<br><br>Air distribution systems – upward air distribution system for theatre, over head distribution system, ejector air distribution system, factors to be considered for– throw or blow, drop, entrainment or induction ratio, spread.<br><br>Types of supply air outlets – grill outlets, slot diffuser, ceiling outlets, perforated ceiling – insulation – thermal and acoustic<br>Basic principles of air flow in ducts – energy equation, total pressure, static pressure, velocity pressure, fan total pressure, fan static pressure, fan velocity, pressure, frictional losses, friction chart, dynamic losses in elbows in sudden enlargements, in contractions, in suction and discharge openings, in fittings. | 14 |

#### **Text Book:**

1. Heat and Mass Transfer by SACHDEVA
2. Heat and Mass Transfer by DOMKUNDWAR
3. Refrigeration and Air-conditioning by Arora and Domkundwar Danpat & Rai Sons Publications

#### **Reference Books:**

1. ISHRAE HAND BOOK ON DESIGN AND SELECTION



DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)

M SCHEME  
2015 -2016 onwards

III YEAR  
VI SEMESTER

ELECTIVE THEORY  
**32482 - R&A/C SYSTEM MAINTENANCE**

CURRICULUM DEVELOPMENT CENTRE

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

**DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)**

**M-SCHEME**

**ELECTIVE**

(to be Implemented for the students Admitted from the Year 2015-2016 onwards)

Course Name : Diploma in Mechanical Engineering(R&A/C)

Subject Code : 32482

Semester : VI Semester

Subject Title : **R & A/C SYSTEM MAINTENANCE**

**TEACHING AND SCHEME OF EXAMINATIONS :**

No. of weeks per Semester : 15 Weeks

| Subject                                       | Instructions   |                     | Examination            |                      |       |          |
|-----------------------------------------------|----------------|---------------------|------------------------|----------------------|-------|----------|
|                                               | Hours/<br>Week | Hours /<br>Semester | Marks                  |                      |       | Duration |
| <b>R &amp; A/C<br/>SYSTEM<br/>MAINTENANCE</b> | 5              | 75                  | Internal<br>Assessment | Board<br>Examination | Total |          |
|                                               |                |                     | 25                     | 75                   | 100   | 3 Hrs    |

**TOPICS AND ALLOCATION OF HOURS**

| Sl.No        | Topic                                               | Time(Hrs.) |
|--------------|-----------------------------------------------------|------------|
| 1.           | Layout & Installation of small systems              | 14         |
| 2.           | Installation of Ducts                               | 14         |
| 3.           | Installation of water pipes and Insulation of pipes | 14         |
| 4.           | Central plant service operations                    | 13         |
| 5.           | Servicing of small Equipments and Trouble shooting  | 13         |
| 6.           | TEST & REVISION                                     | 07         |
| <b>Total</b> |                                                     | <b>75</b>  |

**Rationale :**

To learn about installation of Air-conditioning systems like room air conditioners, packaged air conditioner and central plant air conditioners. Also to learn about the maintenance of air-conditioning systems.

**Objectives:**

- ❖ To understand the layout and installation of small A/C systems
- ❖ To acquire knowledge of installation of ducts
- ❖ To learn about installation of water pipe and insulation
- ❖ To understand the central plant service operation
- ❖ To learn about servicing of small equipments and trouble shooting

### **32482 - R & A/C SYSTEM MAINTENANCE** **DETAILED SYLLABUS**

#### **CONTENTS**

| <b>UNIT</b> | <b>NAME OF TOPICS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Hours</b> |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| I           | <b>Layout &amp; Installation of small systems</b><br><br>Installation of window air-conditioner-Instruction for installation-selection of location-Installation of split air-conditioner--selection of location-layout of equipments-indoor unit mounting-out door unit mounting-piping connections - commissioning of the unit - Layout and Installation of central systems-selection of location-foundation-layout of equipments-layout of piping-layout of ducting and water piping                                         | 14           |
| II          | <b>Installation of Ducts</b><br><br>Duct system components-duct fabrication standards-duct joints-Leakage and sealing – selection of materials-duct ancillaries-duct supports-flexible duct installation-good installation practices-duct testing<br><br>Duct insulation-application and guidelines-storage-preparation-installation procedure – underdeck insulation-design considerations                                                                                                                                    | 14           |
| III         | <b>Installation of water pipes and Insulation of pipes</b><br><br>General requirement-tolerance-valves-threaded connections-flanged connections-pipe support-storage and handling of piping materials-inspection of pipe-pipe supports – piping connection details-pressure testing-commissioning.<br><br>Refrigerant pipe insulation-synthetic insulation for piping-installation and fabricating fitting covers-P trap fitting-snap on method-insulation pipe hangers-correct use of synthetic foam insulation-Adhesive used | 14           |
| IV          | <b>Central plant service operations</b><br><br>Starting the compressor-pressure testing the plant for leaks-Evacuation and Dehydration -vacuum standing test- adding oil to the compressor-commissioning and evaluation of system performance-test operation on commissioning-performance of plant-compressor pump down-removing refrigerant from the system-purging non condensable gases-preparing for a prolonged shut down-starting the system after a prolonged shut down                                                 | 14           |

|   |                                                                                                                                                                                                                                                                                                                                                                                                                                   |    |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
|   |                                                                                                                                                                                                                                                                                                                                                                                                                                   |    |
| V | <b>Servicing of small Equipments and Trouble shooting</b><br>Hermetic compressor-manufacturing characteristics-inspection-running test of hermetic compressor-servicing burnt out compressor-interchanging refrigerant in hermetic system-cooling of hermetic compressors-moisture factor-over charging hermetic motor burnt out-trouble shooting and rectification-procedure for servicing appliances with burnt-out compressor. | 14 |

**Text Book:**

1. Installation and maintenance manual-ISHRAE HAND BOOK

**Reference Books:**

1. Basic Refrigeration and Air-conditioning by P.N.ANANTHA NARAYANAN



DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)

M SCHEME  
2015 -2016 onwards

III YEAR  
VI SEMESTER

**32464 - R&A/C EQUIPMENT SERVICE PRACTICAL**

CURRICULUM DEVELOPMENT CENTRE

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

**DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)  
M-SCHEME**

(to be Implemented for the students Admitted from the Year 2015-2016 onwards)

Course Name : Diploma in Mechanical Engineering(R&A/C)

Subject Code : 32464

Semester : VI Semester

Subject Title : **R & A/C EQUIPMENT SERVICE PRACTICAL**

**TEACHING AND SCHEME OF EXAMINATIONS :**

No. of weeks per Semester : 15 Weeks

| Subject                             | Instructions |                  | Examination         |                   |       |          |
|-------------------------------------|--------------|------------------|---------------------|-------------------|-------|----------|
|                                     | Hours / Week | Hours / Semester | Marks               |                   |       | Duration |
| R & A/C EQUIPMENT SERVICE PRACTICAL | 5            | 75               | Internal Assessment | Board Examination | Total |          |
|                                     |              |                  | 25                  | 75                | 100   |          |

**LIST OF EXPERIMENTS**

**PART A:**

1. Study of R & A/C tools
2. Test the start winding & run winding of the hermetic compressor motor by measuring resistance and find out the condition of the motor
3. Wiring, starting and running of refrigerator system with RSIR starting circuit
4. Wiring, starting and running of refrigerator system with CSIR starting circuit
5. Wiring, starting and running of A/C with PSC starting circuit
6. Wiring, starting and running of A/C with CSCR starting circuit

**PARTB:**

1. Test and replace faulty potential relay and capacitors
2. Identify leaks in a refrigeration system with soap bubble method
3. Brazing and flaring operation on copper pipe
4. Pressure testing of the system before charging
5. Remove and replace a blocked capillary tube

6. Complete evacuation of the refrigeration system
7. Charging refrigerant to the system

### BOARD EXAMINATION - DETAILED ALLOCATION

**Note:** All the experiments have to be completed. Two experiments will be given for examination by selecting one exercise from PART A and one from PART B.

All the experiments should be given in the question paper and students are allowed to select by a lot.

Record note book should be submitted during examination.

### Scheme of Examination

Question PART A :35 marks  
 Question PART B :35 marks  
 Viva voce : 5 marks  
 Total : 75 marks

### LIST OF EQUIPMENTS

| Sno | Equipments                                                                               |
|-----|------------------------------------------------------------------------------------------|
| 1   | Service Tools                                                                            |
| 2   | Hermetically sealed Compressor motor , tongue tester or multimeter                       |
| 3   | Hermetically sealed Compressor with starting Capacitor ,running Capacitor and wiring Kit |
| 4   | Hermetically sealed Compressor with running Capacitor and wiring Kit                     |
| 5   | A/C Compressor , Permanent starting Capacitor with wiring kit                            |
| 6   | A/C test rig with starting Capacitor ,running Capacitor and wiring Kit                   |
| 7   | Refrigeration Compressor with potential relay and capacitors                             |
| 8   | Refrigeration test rig with Nitrogen cylinder                                            |
| 9   | Gas welding set up for brazing operation                                                 |
| 10  | Vacuum pump – ½ HP                                                                       |



DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)

M SCHEME  
2015 -2016 onwards

III YEAR  
VI SEMESTER

**32465 - AIR CONDITIONING PRACTICAL**

CURRICULUM DEVELOPMENT CENTRE

## STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU

### DIPLOMA IN MECHANICAL ENGINEERING(R&A/C) M-SCHEME

(to be Implemented for the students Admitted from the Year 2015-2016 onwards)

Course Name : Diploma in Mechanical Engineering(R&A/C)

Subject Code : 32465

Semester : VI Semester

Subject Title : **AIR CONDITIONING PRACTICAL**

#### **TEACHING AND SCHEME OF EXAMINATIONS :**

No. of weeks per Semester : 15 Weeks

| Subject                          | Instructions   |                     | Examination            |                      |       |          |
|----------------------------------|----------------|---------------------|------------------------|----------------------|-------|----------|
|                                  | Hours/<br>Week | Hours /<br>Semester | Marks                  |                      |       | Duration |
| AIR<br>CONDITIONING<br>PRACTICAL | 5              | 75                  | Internal<br>Assessment | Board<br>Examination | Total |          |
|                                  |                |                     | 25                     | 75                   | 100   | 3 Hrs    |

#### **LIST OF EXPERIMENTS**

##### **PART A:**

1. Tracing of common faults and remedies of window and split Air conditioners
2. Study performance of Voltage stabilizer with time delay circuit.
3. Selection steps for hermetic compressor
4. Identify the refrigerants in service cylinders by measuring pressure and temperature by using p-h tables
5. Finding C, S and R terminals of sealed compressor
6. Determination of efficiency of air washer (air cooler) by using psychrometric chart

##### **PART B:**

1. Identification circuit and wiring of air conditioner
2. Determination of actual COP and capacity of window or split air conditioner
3. Removal and replacement of capillary tube of a window air conditioner
4. Charging refrigerant to a window air conditioner

5. Determination of capacity of air cooled condenser of a window or split air conditioner
6. Testing and replacement of faulty i) capacitor ii) selector switch iii) Potential relay of Air- conditioner
7. Dismantling and Assembly of a vapour compression refrigeration cycle

### BOARD EXAMINATION - DETAILED ALLOCATION

**Note:** All the experiments have to be completed. Two experiments will be given for examination by selecting one experiments from PART A and one from PART B.

All the experiments should be given in the question paper and students are allowed to select by a lot.

Record note book should be submitted during examination.

### Scheme of Examination

Question PART-A :35 marks  
 Question PART-B :35 marks  
 Viva voce : 5 marks  
 Total : 75 marks

### LIST OF EQUIPMENTS

| Sno | Equipments                                                                                     |
|-----|------------------------------------------------------------------------------------------------|
| 1   | Window A/C , Split A/C                                                                         |
| 2   | Voltage Stabiliser with dimmer start                                                           |
| 3   | p-h chart for common refrigerants , service Cylinder with Pressure gauge , temperature sensors |
| 4   | Hermetically sealed compressor with tongue tester                                              |
| 5   | Air cooler/ Air washer set up                                                                  |
| 6   | A/C test rig                                                                                   |
| 7   | Window A/C test rig, Split A/C test rig                                                        |
| 8   | Gas welding set up for brazing operation                                                       |
| 9   | Vacuum pump – ½ HP                                                                             |



DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)

M SCHEME  
2015 -2016 onwards

III YEAR  
VI SEMESTER

ELECTIVE PRACTICAL  
**32483 - DESIGN OF R & A/C PRACTICAL**

CURRICULUM DEVELOPMENT CENTRE

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

**DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)  
M-SCHEME  
ELECTIVE**

(to be Implemented for the students Admitted from the Year 2015-2016 onwards)

Course Name : Diploma in Mechanical Engineering(R&A/C)

Subject Code : 32483

Semester : VI Semester

Subject Title : **DESIGN OF R & A/C PRACTICAL**

**TEACHING AND SCHEME OF EXAMINATIONS :**

No. of weeks per Semester : 15 Weeks

| Subject                                | Instructions |                  | Examination         |                   |       |          |
|----------------------------------------|--------------|------------------|---------------------|-------------------|-------|----------|
|                                        | Hours / Week | Hours / Semester | Marks               |                   |       | Duration |
| <b>DESIGN OF R &amp; A/C PRACTICAL</b> | 4            | 60               | Internal Assessment | Board Examination | Total |          |
|                                        |              |                  | 25                  | 75                | 100   | 3 Hrs    |

**LIST OF EXPERIMENTS**

**PART A:**

1. Study of natural & forced convection heat transfer
2. Study of Heat transfer through different types of fins
3. Study of types of condensers and evaporators
4. Design steps involved in evaporators
5. Study and selection steps of cooling tower
6. Determine capacity of water – cooled condenser

**PART B:**

1. Determine capacity of air – cooled condenser
2. Determine of range, approach and efficiency of cooling tower
3. Effectiveness of Heat exchanger – parallel flow, counter flow and cross flow
4. Determination of thermal conductivity of an insulating material
5. Experiment of heat transfer of composite walls
6. Determination of Air flow measurement in duct using anemometer and orifice meter

## BOARD EXAMINATION - DETAILED ALLOCATION

**Note:** All the experiments have to be completed. Two experiments will be given for examination by selecting one experiments from PART A and one from PART B.

All the experiments should be given in the question paper and students are allowed to select by a lot.

Record note book should be submitted during examination.

### Scheme of Examination

Question PART-A : 35 marks  
Question PART-B: 35 marks  
Viva voce : 5 marks  
Total : 75 marks

### LIST OF EQUIPMENTS

| S.no | Equipments                                                         |
|------|--------------------------------------------------------------------|
| 1    | Window A/C test rig                                                |
| 2    | Cooling tower test rig                                             |
| 3    | Heat exchanger – (parallel flow , Counter flow, Cross flow) set up |
| 4    | Experimental set up for thermal conductivity                       |
| 5    | Composite wall heat transfer experimental set up                   |
| 6    | Air blower with duct set up and Anemometer and Orificemeter        |



DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)

M SCHEME  
2015 -2016 onwards

III YEAR  
VI SEMESTER

ELECTIVE PRACTICAL  
**32484 - R&A/C SYSTEM MAINTENANCE PRACTICAL**

CURRICULUM DEVELOPMENT CENTRE

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

**DIPLOMA IN MECHANICAL ENGINEERING(R&A/C)**

**M-SCHEME**

**ELECTIVE**

(to be Implemented for the students Admitted from the Year 2015-2016 onwards)

Course Name : Diploma in Mechanical Engineering(R&A/C)

Subject Code : 32484

Semester : VI Semester

Subject Title : **R & A/C SYSTEM MAINTENANCE PRACTICAL**

**TEACHING AND SCHEME OF EXAMINATIONS :**

No. of weeks per Semester : 15 Weeks

| Subject                                                     | Instructions   |                     | Examination            |                      |       |          |
|-------------------------------------------------------------|----------------|---------------------|------------------------|----------------------|-------|----------|
|                                                             | Hours/<br>Week | Hours /<br>Semester | Marks                  |                      |       | Duration |
| <b>R &amp; A/C<br/>SYSTEM<br/>MAINTENANCE<br/>PRACTICAL</b> | 4              | 60                  | Internal<br>Assessment | Board<br>Examination | Total |          |
|                                                             |                |                     | 25                     | 75                   | 100   | 3 Hrs    |

**LIST OF EXPERIMENTS**

**PART A:**

1. Installation procedure for split Air-conditioner
2. Installation procedure for Ductable split Air-conditioner
3. Installation procedure for Cassette type Air-conditioner
4. Installation procedure for Package Air-conditioner
5. Installation procedure for Central plant Air-conditioning
6. Installation procedure for Automobile Air-conditioning

**PART B:**

1. Installation procedure for Milk chilling plant
2. Installation procedure for Ice making plant
3. Installation procedure for Air-conditioning system in Hotel
4. Maintenance procedure for central plant Air conditioning system
5. Commissioning procedure for central plant Air conditioning system

## BOARD EXAMINATION - DETAILED ALLOCATION

**Note:** All the experiments have to be completed. Two experiments will be given for examination by selecting one experiments from PART A and one from PART B.

All the experiments should be given in the question paper and students are allowed to select by a lot.

Record note book should be submitted during examination.

**Note:** Question paper should have two questions one from each part.

### Scheme of Examination

Question - A : 35marks

Question - B : 35marks

Viva voce : 5marks

Total : 75marks

### LIST OF EQUIPMENTS

| Sno | Equipments           |
|-----|----------------------|
| 1   | Installation Manuals |



DIRECTORATE OF TECHNICAL EDUCATION  
DIPLOMA IN MECHANICAL ENGINEERING(R&AC)

M SCHEME  
2015 -2016 onwards

III YEAR  
VI SEMESTER

**32467 – PROJECT WORK**

CURRICULUM DEVELOPMENT CENTRE

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

**Course Name** : DIPLOMA IN MECHANICAL ENGINEERING(R & A/C)  
**Course Code** : 1221  
**Subject Code** : 32467  
**Semester** : VI  
**Subject Title** : Project Work

**.TEACHING AND SCHEME OF EXAMINATIONS:**

No. of Weeks per Semester: 15 Weeks

| Subject      | Instruction    |                    | Examination      |            |       |
|--------------|----------------|--------------------|------------------|------------|-------|
|              | Hours/<br>Week | Hours/<br>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         | 6 <sup>th</sup> week  | 10         |
| Second Review        | 12 <sup>th</sup> week | 10         |
| Attendance           | Entire semester       | 5          |
| <b>Total</b>         |                       | <b>25</b>  |

### EVALUATION FOR BOARD EXAMINATION:

| Details of Mark allocation                                                                                                                                                                                                                                                                                                                                                  | MaxMarks  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| 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>4 questions x 2 ½ marks = 10 Marks | 10        |
| <b>Total</b>                                                                                                                                                                                                                                                                                                                                                                | <b>75</b> |

## 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. ENVIRONMENTAL 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 inmates of a multistory building are to be evacuated 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 nearby 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 safety measures taken by them are found to be inadequate.
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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