# CURRICULUM-2020
# (C-20)

# DIPLOMA IN
# MECHANICAL ENGINEERING



## STATE BOARD OF TECHNICAL EDUCATION &   TRAINING

## ANDHRA PRADESH:: VIJAYAWADA

## DIPLOMA IN MECHANICAL ENGINEERING
## CURRICULUM- 2020 (C-20)

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## DIPLOMA PROGRAMMES OF SBTET, AP
## PREAMBLE

The proposed programme intends to develop a skilled technician to support the industries both nationally or globally. It also helps to kindle the spirit of entrepreneurship with necessary skills and theoretical inputs aligning with the National policy of 'Make in India'. The programme also provides for accomplishing higher education goals for those who wish to enrich their theoretical concepts further.

The State Board of Technical Education and Training, (SBTET) AP, has been offering Diploma programmes to meet the above said aspirations of the stake holders: industries, students, academia, parents and the society at large. As such, it has been the practice of SBTET, A.P., to keep the curriculum abreast with the advances in technology through systematic and scientific analysis of current curriculum and bring out an updated revised version at regular intervals. Accordingly the SBTET, AP under the aegis of the Department of Technical Education, Andhra Pradesh in it's 57th Board Meeting held on 05-02-2019 (vide item no: 18) resolved to update the Polytechnic Curriculum C-16 with the guidance of National Institute of Technical Teachers Training & Research (NITTTR), Extension Centre, Vijayawada (ECV), to be implemented with effect from the academic year '20-21.

Analysis of Curriculum C-16 (SWOT analysis) started in the month of June-2019. Feedback was collected from all stake holders: Students, Lecturers, Senior Lecturers, Head of Sections and Principals for all programmes for this purpose. A series of workshops with subject experts followed in the subsequent weeks and the draft curricula were prepared for every programme. Finally, an interactive session with representatives from industries, academia and subject experts was held on 04.01.2020 for thorough perusal and critique of draft curricula; and the suggestions received thus received from Industrialists and academia have been recorded , validated by another set of experienced subject teachers from the Department of Technical education for incorporation into the Curriculum C-20.

The design of new Curricula for the different diploma programmes has thus been finalised with the active participation of the members of the faculty teaching in the Polytechnics of Andhra Pradesh, and duly reviewed by Expert Committee constituted of academicians and representatives from industries. Thus, the primary objective of the curriculum change is to produce employable technicians in the country by correlating the growing needs of the industries with relevant academic input.

The outcome based approach as given by NBA guidelines has been followed throughout the design of this curriculum is designed to meet the requirements of NBA Accreditation, too.

The revised New Curriculum i.e., Curriculum–2020 (C-20) is approved by BoG of SBTET for its implementation with effect from 2020-21.

**Highlights of Curriculum C-20:**

1. Duration of course for regular Diploma and for sandwich Diploma is 3 years and 3½ years respectively.
2. The Curriculum is prepared in Semester Pattern. However, First Year is maintained as Year-wise pattern.
3. 6 Months Industrial training has been introduced for 3 years Diploma Courses and 1 year Industrial Training is introduced for 3 ½ years Sandwich Diploma courses.
4. Updated subjects relevant to the industry are introduced in all the Diploma courses.
5. CISCO course content has been incorporated into the ECE and CME programmes for certification from CISCO in lieu of industrial training when students are unable to get Industrial Training placement in any industry.
6. The policy decisions taken at the State and Central level with regard to environmental science are implemented by including relevant topics in Chemistry. This is also in accordance with the Supreme Court guidelines issued in Sri Mehta's case.
7. Keeping in view the increased need of communication skills which is playing a major role in the success of Diploma Level students in the Industries, emphasis is given for learning and acquiring listening, speaking, reading and writing skills in English. Further as emphasized in the meetings, Communication Skills lab and Life Skills lab are continuing for all the branches.
8. CAD specific to the branch has been given emphasis in the curriculum. Preparing drawings using CAD software has been given more importance.
9. Upon reviewing the existing C-16 curriculum, it is found that the theory content is found to have more weightage than the Practical content. In C-20 curriculum, more emphasis is given to the practical content in Laboratories and Workshops, thus strengthening the practical skills.
10. With increased emphasis for the student to acquire Practical skills, the course content in all the subjects is thoroughly reviewed and structured as outcome based than the conventional procedure based.
11. Curricula of Laboratory and Workshops have been thoroughly revised based on the suggestions received from the industry and faculty, for better utilization of the equipment available in the Polytechnics. The experiments /exercises that are chosen for the practical sessions are identified to confirm to the field requirements of industry.
12. An exclusive section for assessing Higher order Thinking skills (HOTS) has been introduced in summative evaluation.

**Acknowledgements**:

# RULES AND REGULATIONS OF C-20 CURRICULUM

**1    DURATION AND PATTERN OF THE COURSES**

All the Diploma programs run at various institutions are of AICTE approved 3 years or 3½ years duration of academic instruction.

All the Diploma courses are run on year wise pattern in the first year, and the remaining two or two & half years are run in the semester pattern. In respect of few courses like Diploma in Bio-Medical course, the training will be in the seventh semester. Run-through system is adopted for all the Diploma Courses, subject to eligibility conditions.

**2    PROCEDURE FOR ADMISSION INTO THE DIPLOMA COURSES:**

Selection of candidates is governed by the Rules and Regulations laid down in this regard from time to time.

a)  Candidates who wish to seek admission in any of the Diploma courses will have to appear for the Common Entrance Test for admissions into Polytechnics (POLYCET) conducted by the State Board of Technical Education and Training, Andhra Pradesh, Vijayawada.

Only the candidates satisfying the following requirements will be eligible to appear for the Common Entrance Test for admissions into Polytechnics (POLYCET).

b)  The candidates seeking admission should have appeared for S.S.C examination, conducted by the Board of Secondary Education, Andhra Pradesh or equivalent examination thereto, at the time of applying for the Common Entrance Test for admissions into Polytechnics (POLYCET). In case of candidates whose results of their Qualifying Examinations is pending, their selection shall be subject to production of proof of their passing the qualifying examination in one attempt or compartmentally at the time of admission.

c)  Admissions are made based on the merit obtained in the Common Entrance Test (POLYCET) and the reservation rules stipulated by the Government of Andhra Pradesh from time to time.

d)  For admission into the following Diploma Courses for which entry qualification is 10+2, candidates need not appear for POLYCET. A separate notification will be issued for admission into these courses.
    i). D.HMCT ii).D. Pharmacy

**3    MEDIUM OF INSTRUCTION**

The medium of instruction and examination shall be English.

**4    PERMANENT IDENTIFICATION NUMBER (PIN)**

A cumulative / academic record is to be maintained of the Marks secured in sessional work and end examination of each year for determining the eligibility for promotion etc., A Permanent Identification Number (PIN) will be allotted to each admitted candidate to maintain academic records.

**5    NUMBER OF WORKING DAYS PER SEMESTER / YEAR:**

a)  The Academic year for all the Courses shall be in accordance with the Academic Calendar.

b)  The Working days in a week shall be from Monday to Saturday

c)  There shall be 7 periods of 50 minutes duration each on all working days.

d) The minimum number of working days for each semester / year shall be 90 / 180 days excluding examination days.  If this prescribed minimum is not achieved due to any reason, special arrangements shall be made to conduct classes to complete the syllabus.

**6      ELIGIBILITY (ATTENDANCE TO APPEAR FOR THE END EXAMINATION)**
a) A candidate shall be permitted to appear for the end examination in all subjects, if he or she has attended a minimum of 75% of working days during the year/Semester.
b) Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester or 1st year may be granted on medical grounds.
c) A stipulated fee shall be payable towards Condonation for shortage of attendance.
d)  Candidates having less than 65% attendance shall be detained.
e) Students whose shortage of attendance is not condoned in any semester / 1st year and not paid the Condonation fee in time are not eligible to take their end examination of that class and their admissions shall stand cancelled. They may seek re-admission for that semester / 1st year when offered in the next subsequent academic semester/year.
f)      For INDUSTRIAL TRAINING:

i) During Industrial Training the candidate shall put in a minimum of 90% attendance.

ii) If the student fails to secure 90% attendance during industrial training, the student shall reappear for 6 months industrial training at his own expenses.

**7      READMISSION**

Readmission shall be granted to eligible candidates by the respective Principal/ Regional Joint Director.

a) (i) Within 15 days after commencement of class work in any semester (Except Industrial Training).

(ii) For Industrial Training: before commencement of the Industrial training.

b) Within 30 days after commencement of class works in any year (including D. Pharmacy course or first year course in Engineering and Non Engineering Diploma streams).

Otherwise such cases shall not be considered for readmission for that semester / year and are advised to seek readmission in the next subsequent eligible academic year.

The percentage of attendance of the readmitted candidates shall be calculated from the first day of beginning of the regular class work for that year / Semester, as officially announced by CTE/SBTET but not from the day on which he/she has actually reported to the class work.

**8      SCHEME OF Evaluation**

**a) First Year**

**THEORY Courses**: Each Course carries Maximum marks of 80 with examination of 3 hours duration, along with internal assessment for

Maximum of 20 marks. (Sessional marks). However, there are no minimum marks prescribed for sessional.

**Laboratory Courses**: There shall be 40 Marks for internal assessment i.e. sessional marks for each practical Course with an end examination of 3 hours duration carrying 60 marks. However, there are no minimum marks prescribed for sessional.

**b) III, IV, V, VI and VII Semesters:**
**THEORY Courses**: End semester evaluation shall be of 3 hours duration and for a maximum of 80 marks.
**Laboratory Courses**: Each Course carry 60/30 marks of 3hours duration 40/20 sessional marks.

9       **INTERNAL ASSESSMENT SCHEME**

a) **Theory Courses**: Internal assessment shall be conducted for awarding Sessional marks on the dates specified. **Three unit tests shall be conducted for I year students and two Unit Tests for semesters.**
Internal Assessment shall be of 90 minutes duration and for a maximum of 40 marks for each test
The average of marks of all the test, reduced to 20 shall be taken as final Sessional in any case.

b) **Practical Courses**:
(i) **Drawing Courses:**
The award of Sessional marks for internal Assessment shall be as given in the following table:

| Distribution of Marks for the Internal Assessment Marks | | | |
|---|---|---|---|
| First Year (Total:40 Marks) | | Semesters (Total:40 Marks) | |
| Max:20 Marks | Max:20 Marks | Max:20 Marks | Max:20 Marks |
| From the Average of THREE Unit Tests. | From the Average of Assessment of Regular Class work Exercises. | From the Average of TWO Unit Tests. | From the Average of Assessment of Regular Class work Exercises. |

➤ **For first year engineering drawing each unit test will be conducted for duration of 2 hours with maximum marks of 40.**
➤ **(Part - A: 4 questions x 5 marks = 20 Marks ; Part –B: 2 questions x 10 marks = 20 marks ).**
➤ **For the semester drawing examinations, Two Unit tests shall be conducted as per the Board End Examination Question Paper Pattern.**

➤ **All Drawing exercises are to be filed in serial order and secured for further scrutiny by a competent authority**

**(ii) Laboratory Courses:**
Student's performance in Laboratories / Workshop shall be assessed during the year/ semester of study for 40 marks in each practical Course.

**Evaluation for Laboratory Courses, other than drawing courses**:

    i. Instruction (teaching) in laboratory courses (except for the course on Drawing) here after shall be task/competency based as delineated in the Laboratory sheets, prepared by SBTET, AP & NITTTR- ECV and posted in SBTET website.

    ii. Internal assessment for Laboratory shall be done on the basis of task/s performed by the student as delineated in the laboratory sheets, prepared by SBTET, AP & NITTTR- ECV and posted in AP, SBTET website.

    iii. Question paper for End semester Evaluation shall also be task/s based and shall be prepared and distributed by SBTET as done in case of theory courses be prepared as per SBTET rules in vogue.

c) Internal assessment in Labs / workshops / Survey field work etc., during the course of study shall be done and sessional marks shall be awarded by the concerned Teacher.

d) For practical examinations, except in drawing, there shall be two examiners.

External examiner shall be appointed by the Principal in consultation with respective Head of Section preferably choosing a qualified person from in the order of preference.

    i) Nearby Industry

    ii) Govt / Semi Govt organization like R & B, PWD, PR, Railways, BSNL, APSRTC, APSEB etc.

    iii) Govt / University Engg College.

    iv) HoD / Senior Lecture / Lecture from Govt.Polytechnic

    Internal examiner shall be the person concerned with internal assessment as in (c) above. The end examination shall be held along with all theory papers in respect of drawing.

e) Question Paper for Practical: Question paper should cover ( the experiments / exercise prescribed to test various) skills like handling, manipulating, testing, trouble shooting, repair, assembling and dismantling etc., from more than one experiment / exercise

f) Records pertaining to internal assessment marks of both theory and practical Courses are to be maintained for official inspection.

g) **In case of Diploma programs *having* Industrial Training, Internal Assessment and Summative Evaluation**, shall be done as illustrated in the following table:

| Assessment no | Upon completion of | By | Based on | Max Marks |
|---|---|---|---|---|
| 1 | 12 weeks | 1.The faculty concerned | Learning outcomes as given in the scheme of assessment ,for | 120 |

| | | (Guide) and 2. Training in charge (Mentor) of the industry | Industrial Training | |
|---|---|---|---|---|
| 2 | 22 weeks | | | 120 |
| 3.Final summative Evaluation | 24 week | 1.The faculty member concerned, 2.HoD concerned and 3.An external examiner | 1.Demonstration of any one of the skills listed in learning outcomes | 30 |
| | | | 2.Training Report | 20 |
| | | | 3.Viva Voce | 10 |
| | | | **TOTAL** | **300** |

h) Each staff member including Head of Section shall be assigned a batch of students 10 to 15 for making assessment during industrial training.

## 10 MINIMUM PASS MARKS

**THEORY EXAMINATION**:
For passing a theory Course, a candidate has to secure a minimum of 35% in end examination and a combined minimum of 35% of both Sessional and end examination marks put together.

**PRACTICAL EXAMINATION**:
For passing a practical Course, a candidate has to secure a minimum of 50% in end examination and a combined minimum of 50% of both sessional and practical end examination marks put together. In case of D.C.C.P., the pass mark for typewriting and short hand is 45% in the end examination. There are no sessional marks for typewriting and Shorthand Courses of D.C.C.P course.

**INDUSTRIAL TRAINING**:
a) Monitoring
Similar to project work each teacher may be assigned a batch of 10-15 students irrespective of the placement of the students to facilitate effective monitoring of students learning during industrial training.
b) Assessment
The Industrial training shall carry 300 marks and pass marks is 50% in assessments at industry (first and second assessment) and final summative assessment at institution level put together i.e. 150 marks out of 300 marks. And also student has to secure 50% marks in final summative assessment at institution level.

## 11. PROVISION FOR IMPROVEMENT

Improvement is allowed only after he / she has completed all the Courses from First Year to Final semester of the Diploma.

a) Improvement is allowed in any 4 (Four) Courses of the Diploma.
b) The student can avail of this improvement chance **ONLY ONCE**, that too within the succeeding two examinations after the completion of Diploma. However, the duration including Improvement examination shall not exceed **FIVE** years from the year of first admission.
c) No improvement is allowed in Practical / Lab Courses or Project work or Industrial Training assessment. However, improvement in drawing Course(s) is allowed.
d) If improvement is not achieved, the marks obtained in previous Examinations hold good.
e) Improvement is not allowed in respect of the candidates who are punished under Mal-practice in any Examination.
f) Examination fee for improvement shall be paid as per the notification issued by State Board of Technical Education and Training from time to time.
g) All the candidates who wish to appear for improvement of performance shall deposit the original Marks Memos of all the years / Semesters and also original Diploma Certificate to the Board. If there is improvement in performance of the current examination, the revised Memorandum of marks and Original Diploma Certificate will be issued, else the submitted originals will be returned.

## 12. RULES OF PROMOTION FROM 1$^{ST}$ YEAR TO 3$^{rd}$, 4$^{th}$, 5$^{th}$, 6$^{th}$ and 7$^{th}$ SEMESTERS:

**A) For Diploma Courses of 3 Years duration**

i. A candidate shall be permitted to appear for first year examination provided he / she puts in 75% attendance (which can be condoned on Medical grounds up to 10%) i.e. attendance after Condonation on Medical grounds should not be less than 65% and pay the examination fee.

ii. A candidate shall be promoted to 3$^{rd}$ semester if he/she puts the required percentage of attendance in the first year and pays the examination fee. A candidate who could not pay the first year examination fee has to pay the promotion fee as prescribed by State Board of Technical Education and Training, AP from time to time before commencement of 3$^{rd}$ semester.

iii. A candidate shall be promoted to 4$^{th}$ semester provided he/she puts the required percentage of attendance in the 3$^{rd}$ semester and pay the examination fee. A candidate, who could not pay the 3$^{rd}$ semester exam fee, has to pay the promotion fee as prescribed by State Board of Technical Education and Training AP from time to time before commencement of 4$^{th}$ semester.

A candidate is eligible to appear for the 4<sup>th</sup> semester examination if he/she
  a) Puts the required percentage of attendance in the 4<sup>th</sup> semester
  b) Should not have failed in more than four Courses in 1<sup>st</sup> year

### For IVC & ITI Lateral Entry Students:

  a) A candidate is eligible to appear for the 4<sup>th</sup> semester examination if he/she puts the required percentage of attendance in the 4<sup>th</sup> semester
  b) A candidate is eligible to appear for the 4<sup>th</sup> semester examination if he/she clears at least two Courses in third semester.

iv) A candidate shall be promoted to 5<sup>th</sup> semester provided he / she puts the required percentage of attendance in the 4<sup>th</sup> semester and pays the examination fee. A candidate, who could not pay the 4<sup>th</sup> semester examination fee, has to pay the promotion fee as prescribed by State Board of Technical Education and Training from time to time before commencement of 5<sup>th</sup> semester.

A candidate is eligible to appear for the 5<sup>th</sup> semester examination if he/she
  a) Puts the required percentage of attendance in the 5<sup>th</sup> semester
  b) Should get eligibility to appear for 4<sup>th</sup> Semester examination.
     The first backlog exam in 5<sup>th</sup> semester will be conducted only in instant/supplementary diploma examination.

### For IVC& ITI Lateral Entry students:

  a) Puts the required percentage of attendance in the 5<sup>th</sup> semester

v) A candidate shall be sent to Industrial training provided he/she puts in the required percentage of attendance in the 4<sup>th</sup> semester and pay the examination fee/ promotion fee as prescribed by SBTET.
     A candidate is eligible to appear for Industrial Training assessment (Seminar/Viva-voce)
  a) Puts the required percentage of attendance, i.e., 90% in 6th semester Industrial Training

### For IVC & ITI Lateral Entry students:

  a) Puts the required percentage of attendance, ie., 90% in 6<sup>th</sup> semester Industrial Training.
  b) Should get eligibility to appear for 5<sup>th</sup> Semester Examination.

**B) For Diploma Courses of 3 ½ Years duration (MET/ CH/ CHPP/ CHPC/ CHOT/ TT ):**

i. A candidate shall be permitted to appear for 1<sup>st</sup> year examination provided he / she puts in 75% attendance (which can be condoned on Medical grounds up to 10%) i.e. attendance after Condonation on Medical grounds should not be less than 65% and pay the examination fee.

ii. A candidate shall be promoted to 3<sup>rd</sup> semester if he/she puts the required percentage of attendance in the 1<sup>st</sup> year and pays the examination fee. A candidate who could not pay the 1<sup>st</sup> year examination fee has to pay the

promotion fee as prescribed by State Board of Technical Education and Training from time to time before commencement of 3<sup>rd</sup> semester.

iii. A candidate shall be promoted to 4<sup>th</sup> semester provided he/she puts the required percentage of attendance in the 3<sup>rd</sup> semester and pay the examination fee. A candidate, who could not pay the 3<sup>rd</sup> semester exam fee, has to pay the promotion fee as prescribed by State Board of Technical Education and Training from time to time before commencement of 4<sup>th</sup> semester.

A candidate is eligible to appear for the 4<sup>th</sup> semester exam if he/she
a). Puts the required percentage of attendance in the 4<sup>th</sup> semester
b). Should not have failed in more than <u>four backlog Courses of 1<sup>st</sup> year.</u>

**For IVC & ITI Lateral Entry students**:
a) Puts the required percentage of attendance in the 4<sup>th</sup> semester

iv. A candidate shall be promoted to 5th semester industrial training provided he / she puts the required percentage of attendance in the 4th semester and pays the examination fee. A candidate, who could not pay the 4th semester examination fee, has to pay the promotion fee as prescribed by State Board of Technical Education and Training from time to time before commencement of 5th semester.

v. Promotion from 5th to 6th semester is automatic (i.e., from 1st spell of Industrial Training to 2nd spell) provided he/she puts the required percentage of attendance, which in this case ie.,90 % of attendance and attends for the VIVA-VOCE examination at the end of training.

vi. A candidate shall be promoted to 7th semester provided he / she puts the required percentage of attendance in the 6th semester and pays the examination fee. A candidate, who could not pay the 6th semester examination fee, has to pay the promotion fee as prescribed by State Board of Technical Education and Training from time to time before commencement of 7th semester.

vii. A candidate shall be promoted to 7th semester of the course provided he/she has successfully completed both the spells of Industrial Training.

A candidate is eligible to appear for 7th semester examination if he/she
a) Puts in the required percentage of attendance in the 7th semester
b) Should get eligibility to appear for 4<sup>th</sup> semester Examination.
    **For IVC & ITI Lateral Entry students**:
    a) Puts in the required percentage of attendance in the 7th semester
    b) Should not have failed more than four backlog Courses of 3<sup>rd</sup> Semester

**C) For Diploma Courses of 3 ½ Years duration (BM):**

The same rules which are applicable for conventional courses also apply for this course. The industrial training in respect of this course is restricted to one semester (6 months) after the 6$^{th}$ semester (3 years) of the course.

i. A candidate shall be permitted to appear for first year examination provided he / she puts in 75% attendance (which can be condoned on Medical grounds up to 10%) i.e. attendance after Condonation on Medical grounds should not be less than 65% and pay the examination fee.

ii. A candidate shall be promoted to 3$^{rd}$ semester if he/she puts the required percentage of attendance in the first year and pays the examination fee. A candidate who could not pay the first year examination fee has to pay the promotion fee as prescribed by State Board of Technical Education and Training from time to time before commencement of 3$^{rd}$ semester.

iii. A candidate shall be promoted to 4$^{th}$ semester provided he/she puts the required percentage of attendance in the 3$^{rd}$ semester and pay the examination fee. A candidate who could not pay the 3$^{rd}$ semester examination fee, has to pay the promotion fee as prescribed by State Board of Technical Education and Training from time to time before commencement of 4$^{th}$ semester.

A candidate is eligible to appear for the 4$^{th}$ semester examination if he/she

a) Puts in the required percentage of attendance in the 4$^{th}$ semester

b) Should not have failed in more than Four backlog Courses of 1$^{st}$ year

**For IVC & ITI Lateral Entry Students:**
A candidate is eligible to appear for the 4$^{th}$ semester examination if he/she puts the required percentage of attendance in the 4$^{th}$ semester

iv. A candidate shall be promoted to 5$^{th}$ semester provided he / she puts the required percentage of attendance in the 4$^{th}$ semester and pays the examination fee. A candidate, who could not pay the 4$^{th}$ semester examination fee, has to pay the promotion fee as prescribed by State Board of Technical Education and Training from time to time before commencement of   5$^{th}$ semester.

A candidate is eligible to appear for the 5$^{th}$ semester exam if he/she

a) Puts in the required percentage of attendance in the 5$^{th}$ semester.

b) Should get eligibility to appear for 4$^{th}$ Semester examination.

**For IVC & ITI Lateral Entry students**:

a) Puts in the required percentage of attendance in the 5$^{th}$ semester.

b) Should not have failed in more than Four backlog Courses of 3$^{rd}$ Semester.

v. A candidate shall be promoted to 6$^{th}$ semester provided he/she puts in the required percentage of attendance in the 5$^{th}$ semester and pays the examination fee.

A candidate, who could not pay the 5$^{th}$ semester examination fee, has to pay the promotion fee as prescribed by State Board of Technical Education and Training from time to time before commencement of 6$^{th}$ semester.

A candidate is eligible to appear for 6$^{th}$ semester examination

a) Puts in the required percentage of attendance in 6$^{th}$ semester and
b) Should get eligibility to appear for 4$^{th}$ Semester Examination.

**For IVC & ITI Lateral Entry students**:

a) Puts in the required percentage of attendance in 6$^{th}$ semester.
b) Should get eligibility to appear for 5$^{th}$ Semester Examination.

vi. A candidate shall be promoted to 7th semester provided he/she puts in the required percentage of attendance in 6th semester and pay the examination fee. A candidate, who could not pay the 6th semester examination fee, has to pay the promotion fee prescribed by SBTET from time to time before commencement of the 7th semester (Industrial Training).

A candidate is eligible to appear for 7th semester Industrial Training assessment (Seminar/Viva-voce) if he/she

a) Puts in the required percentage of attendance, ie., 90% in 7th semester Industrial Training
b) Should get eligibility to appear for 4th Semester Examination.

**For IVC & ITI Lateral Entry students**:

a) Puts in the required percentage of attendance, ie., 90% in 7$^{th}$ semester Industrial Training.
b) Should get eligibility to appear for 5$^{th}$ Semester Examination.

**Important Note:**

**Seminar/Viva-voce should not be conducted for Not-Eligible Candidates, till the candidate gets eligibility. However, the record of internal Assessment for Industrial Training for 260 marks shall be maintained at Institution Level for all candidates and the data is to be uploaded only for eligible candidates. For not eligible candidates the data is to be uploaded as and when the candidate gets eligibility.**

**OTHER DETAILS**

a) In case a candidate does not successfully complete the Industrial training, he / she will have to repeat the training at his / her own cost.
b) The First spell of Industrial training shall commence 10 days after the completion of the last theory examination of 4th Semester.
c) The Second spell of Industrial training shall commence within 10 days after the completion of first spell of Industrial training.

## 13. STUDENTS PERFORMANCE EVALUATION

Successful candidates shall be awarded the Diploma under the following divisions of pass.

a) First Class with Distinction shall be awarded to the candidates who secure an overall aggregate of 75% marks and above.

b) First Class shall be awarded to candidates who secure overall aggregate of 60% marks and above and below 75% marks.

c) Second Class shall be awarded to candidates who secure a pass with an overall aggregate of below 60%.

   i. The Weightage of marks for various year/Semesters which are taken for computing overall aggregate shall be 25% of I year marks + 100% of 3<sup>rd</sup> and subsequent Semesters.

   ii. In respect IVC & ITI Lateral Entry candidates who are admitted directly into diploma course at the 3<sup>rd</sup> semester (i.e., second year) level the aggregate of (100%) marks secured at the 3<sup>rd</sup> and subsequent semesters of study shall be taken into consideration for determining the overall percentage of marks secured by the candidates for award of class/division.

d) Second Class shall be awarded to all students, who fail to complete the Diploma in the regular 3 years/ 3 ½ years and four subsequent examinations, from the year of first admission.

## 14. EXAMINATION FEE SCHEDULE:

The examination fee should be as per the notification issued by State Board of Technical Education and Training, AP from time to time.

## 15. STRUCTURE OF EXAMINATION QUESTION PAPER:

### I. Formative assessment (Internal examination)

### a) For theory Courses:

Three unit tests for first year and two unit tests for semesters shall be conducted with duration of 90 minutes for each test for maximum marks of 40. It consists of part A and Part B.

**Part A** contains five questions and carries 16 marks. Among these five questions first question consists of four objective items like one word or phrase answer/filling-in the blanks/true or false etc with one mark for each question. The other four questions are short answer questions and carry three marks each.

**Part B** carries 24 marks and consists of three questions with internal choice i.e., either / or type, and each question carries 8 marks.

The sum of marks of 3 tests for I year and 2 tests for semesters shall be reduced to 20 marks in each Course for arriving at final sessional marks.

### b) For drawing Courses:

**For I year:**

Three unit tests with duration of 90 minutes and for maximum marks of 40 marks shall be conducted for first year. It consists of part A and Part B.

Part A consists four questions for maximum marks of 16 and each question carries four marks (4×4 marks=16 marks).

Part B carries maximum marks of 24 and consists of five questions while the student shall answer any three questions out of these five questions. Each question in this part carries a maximum marks of 8, (3×8 marks=24 marks).

The sum of marks obtained in 3 unit test marks shall be reduced to 20 marks for arriving at final sessional marks. Remaining 20 marks are awarded by the Course teacher based on the student's performance during regular class exercise.

**For semester:** Two unit tests with duration of 90 minutes and for maximum marks of 40 marks shall be conducted. The sum of marks obtained in 2 unit test marks shall be reduced to 20 marks for arriving at final sessional marks. Remaining 20 marks are awarded by the Course teacher based on the student's performance during regular class exercise.

**c) For Laboratory /workshop:** 50% of total marks for the Course shall be awarded based on continuous assessment of the student in laboratory/workshop classes and the remaining 50% shall be based on the sum of the marks obtained by the students in two tests.

**II. Summative assessment (End examination)**
The question paper for theory examination is patterned in such a manner that the Weightage of periods/marks allotted for each of the topics for a particular Course be considered. End Examination paper is of 3 hours duration.

a) **Each theory paper consists of Section 'A', 'B' and 'C'.**
   **Section 'A' with Max marks of 30,** contains 10 short answer questions. All questions are to be answered and each carries 3 marks, i.e., 10 x 3 = 30.

   **Section 'B' with Max marks of 40** contains 5 essay type questions including Numerical questions (without any divisions in the question), with internal choice (Either/or type), each carrying 8 marks, i.e., Max. Marks: 5 x 8 = 40.

   **Section 'C' with Max marks of 10** contains single essay type, Higher order Thinking skills question (HoTs)including Numerical questions, without   choice (without any divisions in the question),

   **Thus the total marks for theory examination shall be:  80.**

b) **For Engineering Drawing Course (107) consist of section 'A' and section 'B'.**

**Section 'A' with max marks of 20**, contains four (4) questions. All questions in section 'A' are to be answered to the scale and each carries 5 marks, ie. 4 x 5=20.

**Section 'B' with max marks of 40,** contains six (6) questions. The student shall answer any four (4) questions out of the above six questions and each question carries 10 Marks, i.e., 4 x 10 = 40.

c) **Practical Examinations**

For Workshop practice and Laboratory Examinations, Each student has to pick up a question paper distributed by Lottery System.

Max. Marks for an experiment / exercise :      50
Max. Marks for VIVA-VOCE                  :      10
Total Max. Marks                          :      60

In case of practical examinations with 50 marks, the marks shall be distributed as

Max. Marks for an experiment / exercise :      25
Max. Marks for VIVA-VOCE                  :      05
Total Max. Marks                          :      30

In case of any change in the pattern of question paper, the same shall be informed sufficiently in advance to the candidates.

d) **Note: Evaluation for Laboratory Courses, other than Drawing courses**:

I.   Instruction (teaching) in laboratory courses (except for the course on Drawing) hereafter shall be task/competency based as delineated in the Laboratory sheets, prepared by SBTET, AP and posted in its website.

II.  Internal assessment for Laboratory shall be done on basis of task/s performed by the student as delineated in the laboratory sheets, prepared by SBTET, AP and posted in its website.

III. Question paper for End semester Evaluation shall be prepared as per SBTET rules in vogue.

**16.    ISSUE OF MEMORONDUM OF MARKS**

All candidates who appear for the end examination will be issued memorandum of marks without any payment of fee. However candidates who lose the original memorandum of marks have to pay the prescribed fee to the Secretary, State Board of Technical Education and Training, A.P. for each duplicate memo from time to time.

**17.    MAXIMUM PERIOD FOR COMPLETION OF DIPLOMA Programmes:**

Maximum period for completion of the diploma courses is twice the duration of the course from the date of First admission (includes the period of detention and discontinuation of studies by student etc) failing which they will have to forfeit the claim for qualifying for the award of Diploma (They will not be permitted to appear for examinations after that date). This rule applies for all Diploma courses of 3 years and 3 ½ years of engineering and non-engineering courses.

## 18.  ELIGIBILITY FOR AWARD OF DIPLOMA

A candidate is eligible for award of Diploma Certificate if he / she fulfil the following academic regulations.
i. He / She pursued a course of study for not less than 3 / 3 ½ academic years & not more than 6 / 7 academic years.
ii.  He / she have completed all the Courses.
Students who fail to fulfil all the academic requirements for the award of the Diploma within 6 / 7 academic years from the year of admission shall forfeit their seat in the course & their seat shall stand cancelled.

**For IVC & ITI Lateral Entry students**:

i. He / She pursued a course of study for not less than 2 / 2 ½ academic years & not more than 4 / 5 academic years.
ii. He / she has completed all the Courses.
Students who fail to fulfil all the academic requirements for the award of the Diploma within 4 / 5 academic years from the year of admission shall forfeit their seat in the course & their seat shall stand cancelled.

## 19.  ISSUE OF PHOTO COPY OF VALUED ANSWER SCRIPT, RECOUNTING& REVERIFICATION:

### A) FOR ISSUE OF PHOTO COPIES OF VALUED ANSWER SCRIPTS
I.    A candidate desirous of applying for Photo copy of valued answer script/s should apply within prescribed date from the date of the declaration of the result.
II.   Photo copies of valued answer scripts will be issued to all theory Courses and Drawing Course(s).
III.  The Photo copy of valued answer script will be dispatched to the concerned candidate's address as mentioned in the application form by post.
IV.   No application can be entertained from third parties.

### B) FOR RE-COUNTING(RC) and RE-VERIFICATION(RV) OF THE VALUED ANSWER SCRIPT
i.    A candidate desirous of applying for Re-verification of valued answer script should apply within prescribed date from the date of the declaration of the result.
ii.   Re-verification of valued answer script shall be done for all theory Courses' and Drawing Course(s).
iii.  The Re-verification committee constituted by the Secretary, SBTETAP with Course experts shall re-verify the answer scripts.
I.   **RE-COUNTING**
The Officer of SBTET will verify the marks posted and recount them in the already valued answer script. The variations if any will be

recorded separately, without making any changes on the already valued answer script. The marks awarded in the original answer script are maintained (hidden).

## II. RE-VERIFICATION

(i)     The Committee has to verify the intactness and genuineness of the answer script(s) placed for Re-verification.

(ii)    Initially single member shall carry out the re-verification.

(iii)   On re-verification by single member, if the variation is less than 12% of maximum marks, and if there is no change in the STATUS in the result of the candidate, such cases will not be referred to the next level ie., for 2-Tier evaluation.

(iv)    On re-verification by a single member, if the variation is more than 12% of maximum marks, it will be referred to 2-Tier evaluation.

(v)     If the 2-Tier evaluation confirms variation in marks as more than 12% of maximum marks, the variation is considered as follows:

a) If the candidate has already passed and obtains more than 12% of the maximum marks on Re-verification, then the variation is considered.

b) If the candidate is failed and obtains more than 12% of the maximum marks on Re-verification and secured pass marks on re-verification, then the status of the candidate changes to PASS.

c) If a candidate is failed and obtains more than 12% of the maximum marks on Re-verification and if the marks secured on re-verification are still less than the minimum pass marks, the status of the candidate remain FAIL only.

(vii)   After Re-verification of valued answer script the same or change if any therein on Re-verification, will be communicated to the candidate.

(viii)  On Re-verification of Valued Answer Script if the candidate's marks are revised, the fee paid by the candidate will be refunded or else the candidate has to forfeit the fee amount.

**Note:** No request for Photo copies/ Recounting /Re-verification of valued answer script would be entertained from a candidate who is reported to have resorted to Malpractice in that examination.

## 20. MAL PRACTICE CASES:

If any candidate resorts to Mal Practice during examinations, he / she shall be booked and the Punishment shall be awarded as per SBTETAP rules and regulations in vogue.

## 21. DISCREPANCIES/ PLEAS:

Any Discrepancy /Pleas regarding results etc., shall be represented to the SBTETAP within one month from the date of issue of results. Thereafter, no such cases shall be entertained in any manner.

## 22. ISSUE OF DUPLICATE DIPLOMA

If a candidate loses his/her original Diploma Certificate and desires a duplicate to be issued he/she should produce written evidence to this effect.

He / she may obtain a duplicate from the Secretary, State Board of Technical Education and Training, A.P., on payment of prescribed fee and on production of an affidavit signed before a First Class Magistrate (Judicial) and non-traceable certificate from the Department of Police. In case of damage of original Diploma Certificate, he / she may obtain a duplicate certificate by surrendering the original damaged certificate on payment of prescribed fee to the State Board of Technical Education and Training, A.P.

In case the candidate cannot collect the original Diploma within 1 year from the date of issue of the certificate, the candidate has to pay the penalty prescribed by the SBTET AP from time to time.

**23. ISSUE OF MIGRATION CERTIFICATE AND TRANSCRIPTS:**
The Board on payment of prescribed fee will issue these certificates for the candidates who intend to prosecute Higher Studies in India or Abroad.

**24. The following specific changes are discussed and incorporated in C20 Syllabus:**
   (i) A new subject Theory of Machines is introduced in the V-Semester.
   (ii) Project work is introduced as a practical subject in V-Semester to apply theoretical knowledge to practical work situations.
   (iii) Minimum pass mark of 50% is fixed in the Summative assessment of M-601 Industrial Training subject.
   (iv) The following new topics are introduced to suit the present industrial needs.
   - Rapid Prototype manufacturing Chapter in CAM subject.
   - Drafting/Analysis software packages in CAD Lab.
   - Alternative fuels Chapter in Energy Sources & Power Plant Engineering subject.

**25. GENERAL**
   i. The Board may change or amend the academic rules and regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students, for whom it is intended, with effect from the dates notified by the competent authority.
   ii. All legal matters pertaining to the State Board of Technical Education and Training, AP are within the jurisdiction of Vijayawada.
   iii. In case of any ambiguity in the interpretation of the above rules, the decision of the Secretary, SBTET, A.P is final.

<u>**C-20 CURRICULUM FOR DME**</u>
<u>**WITH INDUSTRIAL TRAINING IN FINAL SEMESTER**</u>

<u>**VISION**</u>

Striving continuously in pursuit of excellence in imparting knowledge with skills in Mechanical Engineering at diploma level to improve the opportunities in employment and higher learning.

## MISSION

| | |
|---|---|
| M1 | Use of technology enhanced tools and techniques by motivated and qualified faculty for enhancement of knowledge, understanding of principles, concepts and latest trends in mechanical engineering. |
| M2 | Modernization of workshops and laboratories as per the curriculum specified by the State Board of Technical Education, Andhra Pradesh. |
| M3 | Conduct of laboratories, guest lectures, industrial visits and industrial training for better understanding of critical concepts of Mechanical Engineering. |
| M4 | Provide opportunities for developing multidisciplinary skills, communication skills, professional attitude and ethics. |

## PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

| | |
|---|---|
| PEO1 | Fundamental knowledge of mathematics, Basic sciences and basic interdisciplinary engineering to apply day to day challenges in the field of mechanical engineering. |
| PEO2 | Knowledge in the principles, concepts, and techniques in mechanical engineering area to solve contemporary issues. |
| PEO3 | Applications of the principles, concepts, and techniques in mechanical engineering area to solve contemporary issues and gain on hand experience. |
| PEO4 | Effective Communication on activities regarding planning, designing, manufacturing, and servicing functions with engineering community. |

## PROGRAMME OUTCOMES (POs)

| | |
|---|---|
| PO1 | **Basic and Discipline Specific Knowledge:** To apply knowledge of mathematics, science and engineering fundamentals and engineering specialization to Engineering Problems. |
| PO2 | **Problem Analysis:** Identify and analyse well-defined engineering problems using codified standard methods mechanical engineering problems for meaningful solutions |
| PO3 | **Design/Development of Solutions:** Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specific needs. |
| PO4 | **Engineering tools, Experimentation and Testing:** Apply modern engineering tools and appropriate techniques to conduct standard tests and measurements. |
| PO5 | **Engineering Practices for Society, Sustainability and Environment:** Apply appropriate technology in context of society, sustainability, environment and ethical practices. |
| PO6 | **Project Management:** Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities. |
| PO7 | **Life-long Learning:** Ability to analyse individual needs and engaging updating in the context of technological changes. |

# PROGRAMME SPECIFIC OUTCOMES (PSOs)

| | |
|---|---|
| PSO1 | Ability to employ in fields of engineering such as design, testing, manufacturing, processing, safety, quality control, and other business sectors. |
| PSO2 | Ability to progress through advanced degree or certificate programs or participates in continuing education in engineering, business, and/or other professionally related fields. |
| PSO3 | Achieve positions of increased responsibility within the organizations. |

# DIPLOMA IN MECHANICAL ENGINEERING
## SCHEME OF INSTRUCTIONS AND EXAMINATIONS
### I YEAR

| Course Code | Course Title | Instruction period / week | | Total Period / year | Scheme of Examination | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | | Theory | Practical /Tutorial | | Duration (hours) | Sessional Marks | End Exam Marks | Total Marks |
| THEORY | | | | | | | | |
| M-101 | English | 3 | - | 90 | 3 | 20 | 80 | 100 |
| M-102 | Engineering Mathematics-I | 5 | - | 150 | 3 | 20 | 80 | 100 |
| M-103 | Engineering Physics | 4 | - | 120 | 3 | 20 | 80 | 100 |
| M-104 | Engineering Chemistry & Environmental Studies | 4 | - | 120 | 3 | 20 | 80 | 100 |
| M-105 | Engineering Mechanics | 4 | - | 120 | 3 | 20 | 80 | 100 |
| M-106 | Workshop Technology | 4 | - | 120 | 3 | 20 | 80 | 100 |
| PRACTICAL | | | | | | | | |
| M-107 | Engineering Drawing | - | 6 | 180 | 3 | 40 | 60 | 100 |
| M-108 | Basic Workshop Practice | - | 6 | 180 | 3 | 40 | 60 | 100 |
| M-109 | Physics Lab | - | 3 | 90 | 3 | 20 | 30 | 50 |
| M-110 | Chemistry Lab | - | 3 | 90 | 3 | 20 | 30 | 50 |
| M-111 | Computer Fundamentals Lab Practice | - | 3 | 90 | 3 | 40 | 60 | 100 |
| *TOTAL* | | 24 | 18 | 1260 | | 280 | 720 | 1000 |

# DIPLOMA IN MECHANICAL ENGINEERING
## SCHEME OF INSTRUCTIONS AND EXAMINATIONS
### III Semester

| Course Code | Course Title | Instruction period / week | | Total Period / year | Scheme of Examination | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Practical/ Tutorial | | Duration (hours) | Sessional Marks | End Exam Marks | Total Marks |
| **THEORY** | | | | | | | | |
| M- 301 | Engineering Mathematics - II | 4 | - | 60 | 3 | 20 | 80 | 100 |
| M -302 | Engineering Materials | 4 | - | 60 | 3 | 20 | 80 | 100 |
| M -303 | Basic Electrical& Electronics Engineering | 4 | - | 60 | 3 | 20 | 80 | 100 |
| M-304 | Basic Thermodynamics | 4 | - | 60 | 3 | 20 | 80 | 100 |
| M-305 | Strength of Materials | 4 | - | 60 | 3 | 20 | 80 | 100 |
| M-306 | Production Technology-I | 4 | - | 60 | 3 | 20 | 80 | 100 |
| **PRACTICAL** | | | | | | | | |
| M-307 | Machine Drawing | - | 6 | 90 | 3 | 40 | 60 | 100 |
| M-308 | Material Testing and Metallography Lab Practice | - | 3 | 45 | 3 | 40 | 60 | 100 |
| M-309 | Fuels Laboratory Practice | | 3 | 45 | 3 | 40 | 60 | 100 |
| M-310 | Electrical Engineering Lab Practice | - | 3 | 45 | 3 | 40 | 60 | 100 |
| M-311 | Workshop Practice -I | - | 3 | 45 | 3 | 40 | 60 | 100 |
| **TOTAL** | | **24** | **18** | **630** | | **320** | **780** | **1100** |

# DIPLOMA IN MECHANICAL ENGINEERING
## SCHEME OF INSTRUCTIONS AND EXAMINATIONS
### IV Semester

| Course Code | Course Title | Instruction period / week | | Total Period / year | Scheme of Examination | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Practical/ Tutorial | | Duration (hours) | Sessional Marks | End Exam Marks | Total Marks |
| **THEORY** | | | | | | | | |
| M – 401 | Engineering Mathematics - III | 3 | - | 45 | 3 | 20 | 80 | 100 |
| M – 402 | Design of Machine Members | 5 | - | 75 | 3 | 20 | 80 | 100 |
| M – 403 | Hydraulics & Fluid Power Systems | 5 | - | 75 | 3 | 20 | 80 | 100 |
| M – 404 | Heat Power Engineering-I | 5 | - | 75 | 3 | 20 | 80 | 100 |
| M – 405 | Energy Sources and Power Plant Engineering | 4 | - | 60 | 3 | 20 | 80 | 100 |
| M – 406 | Production Technology -II | 5 | - | 75 | 3 | 20 | 80 | 100 |
| **PRACTICAL** | | | | | | | | |
| M – 407 | Production Drawing | - | 3 | 45 | 3 | 40 | 60 | 100 |
| M – 408 | Communication Skills Lab Practice | - | 3 | 45 | 3 | 40 | 60 | 100 |
| M – 409 | Thermal Engineering Lab Practice | - | 3 | 45 | 3 | 40 | 60 | 100 |
| M – 410 | Hydraulics & Fluid Power Systems Lab Practice | - | 3 | 45 | 3 | 40 | 60 | 100 |
| M-411 | Workshop Practice- II | - | 3 | 45 | 3 | 40 | 60 | 100 |
| **TOTAL** | | **27** | **15** | **630** | | **320** | **780** | **1100** |

# DIPLOMA IN MECHANICAL ENGINEERING
## SCHEME OF INSTRUCTIONS AND EXAMINATIONS
### V Semester

| Course Code | Course Title | Instruction period / week | | Total Period / year | Scheme of Examination | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Practical /Tutorial | | Duration (hours) | Sessional Marks | End Exam Marks | Total Marks |
| **THEORY** | | | | | | | | |
| M-501 | Industrial Management and Entrepreneurship | 5 | - | 75 | 3 | 20 | 80 | 100 |
| M-502 | Industrial Engineering and Estimation & Costing | 5 | - | 75 | 3 | 20 | 80 | 100 |
| M-503 | Theory of Machines | 4 | - | 60 | 3 | 20 | 80 | 100 |
| M-504 | Heat Power Engineering-II | 4 | - | 60 | 3 | 20 | 80 | 100 |
| M-505 | Refrigeration and Air Conditioning | 5 | - | 75 | 3 | 20 | 80 | 100 |
| M-506 | Computer Aided Manufacturing Systems | 4 | - | 60 | 3 | 20 | 80 | 100 |
| **PRACTICAL** | | | | | | | | |
| M-507 | 507-A CAD Lab Practice<br>507-B CAM Lab Practice | - | 3+3 | 45+45 | 3 | 20<br>20 | 30<br>30 | 100 |
| M-508 | Life skills Lab Practice | - | 3 | 45 | 3 | 40 | 60 | 100 |
| M-509 | R&AC Lab Practice | - | 3 | 45 | 3 | 40 | 60 | 100 |
| M-510 | Project Work | - | 3 | 45 | 3 | 40 | 60 | |
| *TOTAL* | | 27 | 15 | 630 | | 280 | 720 | 1000 |

# DIPLOMA IN MECHANICAL ENGINEERING
## SCHEME OF INSTRUCTIONS AND EXAMINATIONS
## VI Semester

## INDUSTRIAL TRAINING

| Sl. No. | Course | Duration | Scheme of Evaluation | | |
|---|---|---|---|---|---|
| | | | Assessment | Nature | Max. Marks |
| 1 | Industrial Training | 6 months | 1.First Assessment at Industry (After 12 Weeks) | Assessment of Learning outcomes by both the faculty and training Mentor of the industry | 120 |
| | | | 2.Second Assessment at the Industry (After 22 weeks) | Assessment of Learning outcomes by both the faculty and training Mentor of the industry | 120 |
| | | | Final Summative assessment at institution level | Training Report | 20 |
| | | | | Demonstration of any one of the skills listed in learning outcomes | 30 |
| | | | | Viva Voce | 10 |
| | | | | TOTAL MARKS | 300 |

# FIRST YEAR

# DIPLOMA IN MECHANICAL ENGINEERING
## SCHEME OF INSTRUCTIONS AND EXAMINATIONS
## I YEAR

| Course Code | Course Title | Instruction period / week | | Total Period / year | Scheme of Examination | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Practical /Tutorial | | Duration (hours) | Sessional Marks | End Exam Marks | Total Marks |
| THEORY | | | | | | | | |
| M-101 | English | 3 | - | 90 | 3 | 20 | 80 | 100 |
| M-102 | Engineering Mathematics-I | 5 | - | 150 | 3 | 20 | 80 | 100 |
| M-103 | Engineering Physics | 4 | - | 120 | 3 | 20 | 80 | 100 |
| M-104 | Engineering Chemistry & Environmental Studies | 4 | - | 120 | 3 | 20 | 80 | 100 |
| M-105 | Engineering Mechanics | 4 | - | 120 | 3 | 20 | 80 | 100 |
| M-106 | Workshop Technology | 4 | - | 120 | 3 | 20 | 80 | 100 |
| PRACTICAL | | | | | | | | |
| M-107 | Engineering Drawing | - | 6 | 180 | 3 | 40 | 60 | 100 |
| M-108 | Basic Workshop Practice | - | 6 | 180 | 3 | 40 | 60 | 100 |
| M-109 | Physics Lab | - | 3 | 90 | 3 | 20 | 30 | 50 |
| M-110 | Chemistry Lab | - | 3 | 90 | 3 | 20 | 30 | 50 |
| M-110 | Computer Fundamentals Lab Practice | - | 3 | 90 | 3 | 40 | 60 | 100 |
| *TOTAL* | | 24 | 18 | 1260 | | 280 | 720 | 1000 |

## ENGLISH

| Course Code | Course Title | No. of Periods/Week | Total No. of Periods | Marks for FA | Marks for SA |
|---|---|---|---|---|---|
| M-101 | English | 3 | 90 | 20 | 80 |

| S. No. | Unit Title | No of Periods | COs Mapped |
|---|---|---|---|
| 1 | English for Employability | 8 | CO1, CO2, CO3, CO4 |
| 2 | Living in Harmony | 8 | CO1, CO2, CO3, CO4 |
| 3 | Connect with Care | 8 | CO1, CO2, CO3, CO4 |
| 4 | Humour for Happiness | 8 | CO1, CO2, CO3, CO4 |
| 5 | Never Ever Give Up! | 8 | CO1, CO2, CO3, CO4 |
| 6 | Preserve or Perish | 9 | CO1, CO2, CO3, CO4 |
| 7 | The Rainbow of Diversity | 8 | CO1, CO2, CO3, CO4 |
| 8 | New Challenges- Newer Ideas | 8 | CO1, CO2, CO3, CO4 |
| 9 | The End Point First! | 8 | CO1, CO2, CO3, CO4 |
| 10 | The Equal Halves | 8 | CO1, CO2, CO3, CO4 |
| 11 | Dealing with Disaster | 9 | CO1, CO2, CO3, CO4 |
| **Total Periods** | | **90** | |

| Course Objectives | To improve the skills of English Language use by enriching vocabulary and learning accurate structures for effective communication. |
|---|---|
| | To comprehend themes for value based living in professional and personal settings. |

| CO No. | Course Outcomes |
|---|---|
| CO1 | Applies perceptions of themes related to societal responsibility of adolescents towards their surroundings. |
| CO2 | Demonstrates knowledge of form and function of 'grammar items' and use them in both academic and everyday situations. |
| CO3 | Demonstrates effective English communication skills with competence in listening, speaking, reading and writing in academic, professional and everyday contexts. |
| CO4 | Displays positivity and values of harmonious living in personal and professional spheres as reflected through communication. |

**Blue Print of Question Paper:**

| S. No. | Name of the Unit | Periods Allocated | Weightage Allocated | Marks Wise Distribution of Weightage | | | | Question Wise Distribution of Weightage | | | | CO's Mapped |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | R | U | Ap | An | R | U | Ap | An | |
| 1 | English for Employability | 8 | 17 | 3 | | | | 1 | | | | CO1, CO2, CO3, CO4 |
| 2 | Living in Harmony | 8 | | 3 | 8* | | | 1 | 1* | 1* | | CO1, CO2, CO3, CO4 |
| 3 | Connect with Care | 8 | | | | 3 | | | | | | CO1, CO2, CO3, CO4 |
| 4 | Humour for Happiness | 8 | 14 | | 3 | | | | 1 | | | CO1, CO2, CO3, CO4 |
| 5 | Never Ever Give Up! | 8 | | | 3 | 8* | | | 1 | 1* | | CO1, CO2, CO3, CO4 |
| 6 | Preserve or Perish | 9 | 14 | | 8* | 3 | | | 1* | 1 | | CO1, CO2, CO3, CO4 |
| 7 | The Rainbow of Diversity | 8 | | | | 3 | | | | | 1 | CO1, CO2, CO3, CO4 |
| 8 | New Challenges - Newer Ideas | 8 | 35 | | | | | | | | | CO1, CO2, CO3, CO4 |
| 9 | The End Point First! | 8 | | | 8* | 8*+3+3+3 | | | 1* | 4 | | CO1, CO2, CO3, CO4 |
| 10 | The Equal Halves | 8 | | | | | 10* | | | | 1* | CO1, CO2, CO3, CO4 |
| 11 | Dealing with Disasters | 9 | | | | | | | | | | CO1, CO2, CO3, CO4 |
| | **TOTAL** | **90** | **80** | **6** | **30** | **34** | **10** | **2** | **5** | **8** | **1** | |

| PART-A: 10 Questions 3 marks each =30 Marks | All Questions are compulsory : 60 minutes |
|---|---|
| PART-B: 5 Questions 8 marks each =40 Marks | Internal choice : 90 minutes |
| Part-C: 1 Question 10 marks =10 Marks (Higher Order Question) | No choice, one compulsory question : 30 minutes |

**NOTE: * indicates questions can be given from any of the corresponding lessons in the blue print.**

## Question Paper Pattern for Unit Tests

Part A: 16 marks:  4 questions with 1 mark each (FIB, True/false, one word/phrase, etc.)

4 questions with 3 marks each (short answer/ descriptive/ applicative questions)

Part B: 24 marks:  3 questions 8 marks each with internal choice

## Learning Outcomes

**1. English for Employability**
  1.1. Explain the need for improving communication in English for employability
  1.2. Use adjectives and articles effectively while speaking and in writing
  1.3. Write simple sentences

**2. Living in Harmony**
  2.1. Develop positive self-esteem for harmonious relationships
  2.2. Use affixation to form new words
  2.3. Use prepositions and use a few phrasal verbs contextually

**3. Connect with Care**
  3.1. Use social media with discretion
  3.2. Speak about abilities and possibilities
  3.3. Make requests and express obligations
  3.4. Use modal verbs and main verbs in appropriate form
  3.5. Write short dialogues for everyday situations

**4. Humour for Happiness**
  4.1. Explain the importance of humour for a healthy living
  4.2. Improve vocabulary related to the theme
  4.3. Display reading and speaking skills
  4.4. Frame sentences with proper Subject – Verb agreement
  4.5. Explain the features of a good paragraph and learn how to gather ideas as a preliminary step for writing a good paragraph.

**5. Never Ever Give Up!**
5.1. Practice to deal with failures in life.
5.2. Use the present tense form for various every day communicative functions such as speaking and writing about routines, professions, scientific descriptions and sports commentary.
5.3.    Write paragraphs with coherence and other necessary skills.

**6. Preserve or Perish**
6.1. Describe the ecological challenges that we face today and act to save the environment.
6.2. Narrate / Report past events.

6.3. Develop vocabulary related to environment.

6.4. Write e-mails.

**7. The Rainbow of Diversity**

7.1. Illustrate and value other cultures for a happy living in multi-cultural workspace

7.2. Use different types of sentences

7.3. Ask for or give directions, information, instructions

7.4. Use language to express emotions in various situations

7.5. Write letters in various real life situations

**8. New Challenges – Newer Ideas**

8.1. Explain the functional difference between Active Voice and Passive Voice

8.2. Use Passive Voice to speak and write in various contexts

8.3. List the major parts and salient features of an essay

8.4. Explain latest innovations and get motivated

**9. The End Point First!**

9.1. Illustrate the importance of setting a goal in life

9.2. Report about what others have said both in speaking and writing

9.3. Write an essay following the structure in a cohesive and comprehensive manner

9.4. Apply the words related to Goal Setting in conversations and in life

**10. The Equal Halves**

10.1. Value the other genders and develop a gender-balanced view towards life

10.2. Identify the use of different conjunctions in synthesising sentences

10.3. Write various types of sentences to compare and contrast the ideas

10.4. Apply the knowledge of sentence synthesis in revising and rewriting short essays

10.5. Develop discourses in speech and writing

**11. Dealing with Disasters**

11.1. Speak and write about different kinds of disasters and the concept of disaster management

11.2. Generate vocabulary relevant to disaster management and use it in sentences

11.3. Analyse an error in a sentence and correct it

11.4. Write different kinds of reports

**Textbook:** INTERACT (A Textbook for I Year English) - Published by SBTET, AP

**Reference Books:**

Martin Hewings : Advanced Grammar in Use, Cambridge University Press

Murphy, Raymond : English Grammar in Use, Cambridge University Press

Sidney Greenbaum : Oxford English Grammar, Oxford University Press

Wren and Martin (Revised By N.D.V. Prasad Rao) : English Grammar and Composition, Blackie ELT Books, S.

Chand and Co.

Sarah Freeman : Strengthen Your Writing, Macmillan

## ENGINEERING MATHEMATICS-I

| Course Code | Course Title | No. of Periods/week | Total No. of periods | Marks for FA | Marks for SA |
|---|---|---|---|---|---|
| M-102 | Engineering Mathematics-I | 5 | 150 | 20 | 80 |

| S.No. | Unit Title | No. of periods | COs mapped |
|---|---|---|---|
| 1 | Algebra | 31 | CO1 |
| 2 | Trigonometry | 44 | CO2 |
| 3 | Co-ordinate Geometry | 23 | CO3 |
| 4 | Differential Calculus | 33 | CO4 |
| 5 | Applications of Differentiation | 19 | CO4, CO5 |
| | **Total Periods** | **150** | |

| Course Objectives | (i) To apply the principles of Algebra, Trigonometry and Co-Ordinate Geometry to real-time problems in engineering. <br> (ii) To comprehend and apply the concept of Differential Calculus in engineering applications. |
|---|---|

| Course Outcomes | CO1 | Identify various functions, resolve partial fractions and solve problems on matrices. |
|---|---|---|
| | CO2 | Solve problems using the concept of trigonometric functions, their inverses and complex numbers. |
| | CO3 | Find the equations and properties of straight lines, circles and conic sections in coordinate system. |
| | CO4 | Evaluate the limits and derivatives of various functions. |
| | CO5 | Evaluate solutions for engineering problems using differentiation. |

**ENGINEERING MATHEMATICS – I**
**COMMON TO ALL BRANCHES**
**Learning Outcomes**
**UNIT - I**

**C.O. 1 Identify various functions, resolve partial fractions and solve problems on matrices.**

**L.O.** 1.1 Define set, ordered pairs and Cartesian product - examples.

1.2 Explain Relations and functions – examples

1.3 Find Domain & Range of functions – simple examples.

1.4 Classify types of functions (into, many-to-one, one-one, onto and bijective).

1.5 Define inverse functions - examples.

1.6 Define rational, proper and improper fractions of polynomials.

1.7 Explain the procedure of resolving rational fractions of the type mentioned
below into partial fractions

$$i) \quad \frac{f(x)}{(ax+b)(cx+d)} \quad ii) \quad \frac{f(x)}{(ax+b)^2(cx+d)}$$

$$iii) \quad \frac{f(x)}{(x^2+a^2)(bx+c)} \quad iv) \quad \frac{f(x)}{(x^2+a^2)(x^2+b^2)}$$

1.8  Define  a matrix and order of a matrix.

1.9 State various types of matrices with examples (emphasis on $3^{rd}$ order square
matrices).

1.10 Compute sum, scalar multiplication and product of matrices. Illustrate the
properties of these operations such as associative, distributive, commutative
properties with examples and counter examples.

1.11 Define the transpose of a matrix and write its properties;

1.12 Define symmetric and skew-symmetric matrices with examples   Resolve a
square matrix into a sum of a symmetric and skew- symmetric matrices and
provide examples.

1.13 Define determinant of a square matrix, minor, co-factor of an element of a
3x3 square matrix with examples. Expand the determinant of a 3 x 3 matrix
using Laplace expansion formula. State and apply the properties of
determinants to solve problems.

1.14 Distinguish singular and non-singular matrices. Define multiplicative inverse
of a matrix and list properties of adjoint and inverse. Compute adjoint and
multiplicative inverse of a square matrix.

1.15   Solve system of 3 linear equations in 3 unknowns using Cramer's rule and
matrix inversion method.

## UNIT - II

**C.O.2  Solve problems using the concept of trigonometric functions, their inverses and complex numbers.**

**L.O.** 2.1 Define trigonometric ratios of any angle.

2.2 List the values of trigonometric ratios at specified values.

2.3 Draw graphs of trigonometric functions.

2.4 Explain periodicity of trigonometric functions.

2.5 Define compound angles and state the formulae of sin(A±B), cos(A±B), tan(A±B) and cot(A±B).

2.6 Give simple examples on compound angles to derive the values of $\sin 15^0$, $\cos 15^0$, $\sin 75^0$, $\cos 75^0$, $\tan 15^0$, $\tan 75^0$ etc.

2.7 Derive identities like sin(A+B) sin(A-B) = $\sin^2 A - \sin^2 B$ etc.

2.8 Solve simple problems on compound angles.

2.9 Derive the formulae of multiple angles 2A, 3A etc and sub multiple angles A/2 in terms of angle A of trigonometric functions.

2.10 Derive useful allied formulas like $\sin^2 A = (1 - \cos 2A)/2$ etc.

2.11 Solve simple problems using the above formulae

Syllabus for Unit test-I completed

2.12  Derive the formulae on transforming sum or difference of two trigonometric ratios into a product and vice versa, examples on these formulae.

2.13  Solve problems by applying these formulae to sum or difference or product of three or more terms.

2.14 Explain the concept of the inverse of a trigonometric function by selecting an appropriate domain and range.

2.15 Define inverses of six trigonometric functions along with their domains and ranges.

2.16 Derive relations between inverse trigonometric functions so that given A= $\sin^{-1}x$, express angle A in terms of other inverse trigonometric  functions with examples.

2.17 State various properties of inverse trigonometric functions and identities like

$$\sin^{-1}x + \cos^{-1} x = \frac{\pi}{2} \quad \text{etc.}$$

2.18 Apply formulae like $\tan^{-1} x + \tan^{-1} y = \tan^{-1}\left(\dfrac{x+y}{1-xy}\right),\ where\ x \geq 0, y \geq 0, xy < 1$  etc.,

to solve Simple problems.

2.19 Explain what is meant by solutions of trigonometric equations and find the general solutions of sin x=k, cos x =k and tan x=k with appropriate examples.

2.20 Solve models of the type a $\sin^2 x + b \sin x + c = 0$, a cos x + b sin x=c etc., and problems using simple transformations.

2.21 State sine rule, cosine rule, tangent rule and projection rule.

2.22 Explain the formulae for sin A/2, cos A/2, tan A/2 and cot A/2 in terms of semi-perimeter $s$ and sides a,b,c and solve problems.

2.23 List various formulae for the area of a triangle.

2.24 Solve problems using the above formulae.

2.25 Define Sinh x, cosh x and tanh x and list the hyperbolic identities.

2.26 Represent inverse hyperbolic functions in terms of logarithms.

2.27 Define complex number, its modulus , conjugate and list their properties.

2.28 Define the operations on complex numbers with examples.

2.29 Define amplitude of a complex number.

2.30 Represent the complex number in various forms like modulus-amplitude (polar) form, Exponential (Euler) form with examples.

2.31 Write DeMoivre's theorem (without proof) and illustrate with simple examples.

## UNIT - III

**Coordinate Geometry**

**C.O. 3 Find the equations and properties of straight lines, circles and conic sections in coordinate system.**

**L.O.** 3.1 Write the different forms of a straight line – general form, point-slope form, slope-intercept form, two-point form, intercept form and normal form or perpendicular form.

3.2 Solve simple problems on the above forms.

3.3 Find distance of a point from a line, acute angle between two lines, intersection of two non-parallel lines and distance between two parallel lines.

3.4 Define locus of a point and define a circle.

3.5 Write the general equation of a circle and find the centre and radius.

3.6 Find the equation of a circle given (i) centre and radius, (ii) two ends of a diameter (iii) Centre and a point on the circumference (iv) three non collinear points.

3.7. Define a conic section.

3.8 Explain the terms focus, directrix, eccentricity, axes and latus rectum of a conic with illustrations.

3.9 Find the equation of a conic when focus, directrix and eccentricity are given.

3.10 Describe the properties of Parabola, Ellipse and Hyperbola in standard forms whose axes are along co-ordinate axes and solve simple examples on above.

Syllabus for Unit test-II completed

**C.O.4 Evaluate the limits and derivatives of various functions.**

L.O. 4.1 Explain the concept of limit and meaning of $\lim\limits_{x \to a} f(x) = l$ and state the properties of limits.

4.2 Evaluate the limits of the type $\lim\limits_{x \to l} \dfrac{f(x)}{g(x)}$ and $\lim\limits_{x \to \infty} \dfrac{f(x)}{g(x)}$

4.3 Mention the Standard limits $\lim\limits_{x \to a} \dfrac{x^n - a^n}{x - a}$, $\lim\limits_{x \to 0} \dfrac{\sin x}{x}$, $\lim\limits_{x \to 0} \dfrac{\tan x}{x}$, $\lim\limits_{x \to 0} \dfrac{a^x - 1}{x}$,

$\lim\limits_{x \to 0} \dfrac{e^x - 1}{x}$, $\lim\limits_{x \to 0} (1 + x)^{\frac{1}{x}}$, $\lim\limits_{x \to \infty} \left(1 + \dfrac{1}{x}\right)^x$ (without proof) and solve the problems using these standard limits.

4.4 Explain the concept of continuity of a function at a point and on an interval with some examples whether a given function is continuous or not.

4.5 State the concept of derivative of a function $y = f(x)$ – definition, first principle as

$\lim\limits_{h \to 0} \dfrac{f(x+h) - f(x)}{h}$ and also provide standard notations to denote the derivative of a function.

4.6 State the significance of derivative in scientific and engineering applications.

4.7 Find the derivatives of elementary functions like $x^n$, $a^x$, $e^x$, log x, sin x, cos x, tanx, Secx, Cosecx and Cot x using the first principles.

4.8 Find the derivatives of simple functions from the first principle .

4.9 State the rules of differentiation of sum, difference, scalar multiplication, product and quotient of functions with illustrative and simple examples.

4.10 Explain the method of differentiation of a function of a function (Chain rule) with illustrative examples.

4.11 Find the derivatives of Inverse Trigonometric functions and examples using the Trigonometric transformations.

4.12 Explain the method of differentiation of a function with respect to another function and also differentiation of parametric functions with examples.

4.13 Find the derivatives of hyperbolic functions.

4.14 Explain the procedures for finding the derivatives of implicit function with examples.

4.15 Explain the need of taking logarithms for differentiating some functions with examples like $[f(x)]^{g(x)}$.

4.16 Explain the concept of finding the higher order derivatives of second and third order with examples.

4.17 Explain the concept of functions of several variables, partial derivatives and difference between the ordinary and partial derivatives with simple examples.

4.18 Explain the definition of Homogenous function of degree n.

4.19 Explain Euler's theorem for homogeneous functions with applications to simple problems.


**C.O. 5 Evaluate solutions for engineering problems using differentiation.**

**L.O.** 5.1 State the geometrical meaning of the derivative as the slope of the tangent to the curve y=f(x) at any point on the curve.

5.2 Explain the concept of derivative to find the slope of tangent and to find the equation of tangent and normal to the curve y=f(x) at any point on it.

5.3 Find the lengths of tangent, normal, sub-tangent and sub normal at any point on the curve y=f(x) .

5.4 Explain the derivative as a rate of change in distance-time relations to find the velocity and acceleration of a moving particle with examples.

5.5 Explain the derivative as a rate measurer in the problems where the quantities like volumes, areas vary with respect to time- illustrative examples.

5.6 Define the concept of increasing and decreasing functions.

5.7 Explain the conditions to find points where the given function is increasing or decreasing with illustrative examples.

5.8 Explain the procedure to find the extreme values (maxima or minima) of a function of single variable- simple problems yielding maxima and minima.

5.9 Solve problems on maxima and minima in applications like finding areas, volumes etc.

5.10 Apply the concept of derivatives to find the errors and approximations in simple problems.

| Syllabus for Unit test-III completed |
| --- |

**Unit-I**
**Algebra**
**1. Relations and Functions**:
   Define Set, Ordered pairs, Cartesian product, Relations, functions, domain & range of functions. Describe types of functions (in-to, many-to-one, one-one, onto and bijective) and inverse functions – examples.

**2. Partial Fractions:**
   Define rational, proper and improper fractions of polynomials. Resolve rational fractions in to their partial fractions covering the types mentioned below.

$$i) \quad \frac{f(x)}{(ax+b)(cx+d)} \quad ii) \quad \frac{f(x)}{(ax+b)^2(cx+d)}$$

$$iii) \quad \frac{f(x)}{(x^2+a^2)(bx+c)} \quad iv) \quad \frac{f(x)}{(x^2+a^2)(x^2+b^2)}$$

**3. Matrices:**
   Definition of a matrix, types of matrices-examples, algebra of matrices-equality of two matrices, sum, scalar multiplication and product of matrices. Transpose of a matrix-Symmetric, skew symmetric matrices-Minor, cofactor of an element-Determinant of a square matrix-Laplace's expansion, properties of determinants. Singular and non-singular matrices-Adjoint and multiplicative inverse of a square matrix- examples-System of linear equations in 3 variables-Solutions by Cramers's rule and Matrix inversion method-examples.

**Unit-II**
**Trigonometry**

**4. Trigonometric ratios:**
   Definition of trigonometric ratios of any angle, values of trigonometric ratios at specified values, draw graphs of trigonometric functions, periodicity of trigonometric functions.
**5. Compound angles:**
   Formulas of sin(A±B), cos(A±B), tan(A±B),cot(A±B),and related identities with problems.
**6. Multiple and sub multiple angles:**
   Formulae for trigonometric ratios of multiple angles 2A, 3A and sub multiple angles A/2 with problems.
**7**. Transformations of products into sums or differences and vice versa simple problems
**8. Inverse trigonometric functions:**
   Definition, domains and ranges-basic properties- problems.
**9. Trigonometric equations:**
   Concept of a solution, principal value and general solution of trigonometric equations:
   sinx =k , cosx= k, tanx =k, where k is a constant. Solutions of simple quadratic equations, equations involving usage of transformations- problems.

**10. Properties of triangles:**
   Relation between sides and angles of a triangle- sine rule, cosine rule,  tangent rule and projection rule-area of a triangle-  problems.

**11.  Hyperbolic functions:**
   Definitions of hyperbolic functions, identities of hyperbolic functions, inverse hyperbolic functions and expression of inverse hyperbolic functions in terms of logarithms.

**12. Complex Numbers:**
   Definition of a complex number, Modulus and conjugate of a complex number, Arithmetic operations on complex numbers, Modulus- Amplitue (polar) form , Exponential form (Euler form) of a complex number- Problems. DeMoivre's theorem.

### UNIT-III
### Coordinate geometry
**13.  Straight lines:** various forms of straight lines, angle between lines, perpendicular distance from a point, distance between parallel lines-examples.
**14. Circle:** locus of a point, Circle, definition-Circle equation given (i) centre and radius, (ii) ends of a diameter (iii) centre and a point on the circumference (iv) three non collinear points - general equation of a circle – finding centre, radius.
**15.** Definition of a conic section, equation of a conic when focus directrix and eccentricity are given. properties of parabola, ellipse and hyperbola in standard forms.

### UNIT-IV
### Differential Calculus:
**16. Concept of Limit-** Definition- Properties of Limits and Standard Limits -Simple Problems-Continuity of a function at a point- Simple Examples only.

**17. Concept of derivative-** Definition (first principle)- different notations-derivatives of elementary functions- problems.  Derivatives of sum, product, quotient, scalar multiplication of functions - problems.  Chain rule, derivatives of inverse trigonometric functions, derivative of a function with respect to another function, derivative of parametric functions, derivative of hyperbolic, implicit functions, logarithmic differentiation –  problems in each case.  Higher order derivatives - examples – functions of several variables - partial differentiation, Euler's theorem-simple problems.

### UNIT-V
### Applications of Derivatives:
**18**. Geometrical meaning of the derivative, equations of Tangent and normal to a curve at any point.  Lengths of tangent, normal, sub tangent and subnormal to the curve at any point - problems.
**19**. Physical applications of the derivative – velocity, acceleration, derivative as a rate measure –Problems.
**20**. Applications of the derivative to find the extreme values – Increasing and decreasing functions, finding the maxima and minima of simple functions - problems leading to applications of maxima and minima.
**21**. Using the concept of derivative of a function of single variable, find the absolute error, and percentage errors and approximate values due to errors in measuring.

**Textbook:**
Engineering Mathematics-I, a textbook for first year diploma courses, prepared &
prescribed by SBTET, AP.

**Reference Books:**
1. Shanti Narayan, A Textbook of matrices, S. Chand &Co.
2. Robert E. Moyer & Frank Ayers Jr., Schaum's Outline of Trigonometry, 4th
   Edition, Schaum's Series
3. M. Vygodsky, Mathematical Handbook, Mir Publishers, Moscow.
4. Frank Ayers & Elliott Mendelson, Schaum's Outline of Calculus, Schaum's
Series

## Engineering Mathematics – I
## Blue print

| S.No | Chapter/ Unit title | No of Periods | | Weight age Allotted | Marks wise distribution of weight age | | | | Question wise distribution of weight age | | | | COs mapped |
|------|---------------------|--------|----------|------|----|----|----|----|----|----|----|----|--------|
| | **Unit - I : Algebra** | **Theory** | **Practice** | | **R** | **U** | **Ap** | **An** | **R** | **U** | **Ap** | **An** | |
| 1 | Relations and Functions | 4 | 2 | 3 | 0 | 3 | 0 | 0 | 0 | 1 | 0 | 0 | **CO 1** |
| 2 | Partial Fractions | 3 | 2 | 3 | 0 | 3 | 0 | 0 | 0 | 1 | 0 | 0 | **CO 1** |
| 3 | Matrices and Determinants | 10 | 10 | 11 | 3 | 0 | 8 | 0 | 1 | 0 | 1 | 0 | **CO 1** |
| | **Unit - II : Trigonometry** | | | | | | | | | | | | |
| 4 | Trigonometric Ratios | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **CO2** |
| 5 | Compound Angles | 3 | 2 | 3 | 3 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | **CO2** |
| 6 | Multiple and Submultiple angles | 4 | 4 | 3 | 0 | 3 | 0 | 0 | 0 | 1 | 0 | 0 | **CO2** |
| 7 | Transformations | 3 | 3 | 8 | 0 | 8 | 0 | 0 | 0 | 1 | 0 | 0 | **CO2** |
| 8 | Inverse Trigonometric Functions | 3 | 2 | | | | | | | | | | |
| 9 | Trigonometric Equations | 3 | 2 | 8 | 0 | 0 | 8 | 0 | 0 | 0 | 1 | 0 | **CO2** |
| 10 | Properties of triangles | 3 | 2 | | | | | | | | | | |
| 11 | Hyperbolic Functions | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **CO2** |
| 12 | Complex Numbers | 4 | 2 | 3 | 3 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | **CO2** |

| No | Topic | | | | | | | | | | | | CO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Unit III : Co-ordinate Geometry** | | | | | | | | | | | | |
| 13 | Straight Lines | 4 | 2 | 3 | 3 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | **CO3** |
| 14 | Circle | 3 | 2 | 8 | 0 | 8 | 0 | 0 | 0 | 1 | 0 | 0 | **CO3** |
| 15 | Conic Sections | 8 | 4 | | | | | | | | | | |
| | **Unit – IV : Differential Calculus** | | | | | | | | | | | | |
| 16 | Limits and Continuity | 4 | 2 | 3 | 0 | 3 | 0 | 0 | 0 | 1 | 0 | 0 | **CO4** |
| 17 | Differentiation | 17 | 10 | 14 | 3 | 11 | 0 | 0 | 1 | 2 | 0 | 0 | **CO4** |
| | **Unit - V : Applications of Differentiation** | | | | | | | | | | | | |
| 18 | Geometrical Applications | 3 | 2 | 10 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 1 | **CO5** |
| 19 | Physical Applications | 2 | 2 | | | | | | | | | | |
| 20 | Maxima and Minima | 3 | 4 | | | | | | | | | | |
| 21 | Errors and Approximations | 2 | 1 | | | | | | | | | | |
| | **Total** | **89** | **61** | **80** | **15** | **39** | **16** | **10** | **5** | **8** | **2** | **1** | |

**R: Remembering Type**      **: 15 Marks**
**U: understanding Type**      **: 39 Marks**
**Ap: Application Type**      **: 16 Marks**
**An: Analysing Type**      **: 10 Marks**

## Engineering Mathematics – I
## Unit Test Syllabus

| Unit Test | Syllabus |
|---|---|
| **Unit Test-I** | From L.O. 1.1 to L.O. 2.11 |
| **Unit Test-II** | From L.O. 2.12 to L.O. 3.10 |
| **Unit Test-III** | From L.O.4.1 to L.O. 5.10 |

# ENGINEERING PHYSICS

| Course code | Course Title | No. of Periods per week | Total No. of Periods | Marks for FA | Marks for SA |
|---|---|---|---|---|---|
| M-103 | Engineering Physics | 4 | 120 | 20 | 80 |

| S. No | Unit Title/Chapter | No of Periods | COs Mapped |
|---|---|---|---|
| 1 | Units and Dimensions | 08 | CO1 |
| 2 | Elements of Vectors | 12 | CO1 |
| 3 | Dynamics | 12 | CO2 |
| 4 | Friction | 10 | CO2 |
| 5 | Work, Power and Energy | 12 | CO3 |
| 6 | Simple harmonic motion | 12 | CO3 |
| 7 | Heat and Thermodynamics | 12 | CO4 |
| 8 | Sound | 10 | CO4 |
| 9 | Properties of matter | 10 | CO5 |
| 10 | Electricity and Magnetism | 12 | CO5 |
| 11 | Modern physics | 10 | CO5 |
| **Total** | | **120** | |

| Course Title: Engineering Physics | |
|---|---|
| **Course Objectives** | 1. To familiarize with the concepts of Physics involved in the process of various Engineering, Industrial and Daily life Applications.<br>2. To understand and apply the basic principles of physics in the field of engineering and technology to familiarize certain natural phenomenon occurring in the day to day life<br>3. To reinforce theoretical concepts by conducting relevant experiments/exercises |

| | CO1 | Explain S.I units and dimensions of different physical quantities, basic operations among vector quantities. |
|---|---|---|
| | CO2 | Explain the motion of objects moving in one dimension and two dimensions, the causes of motion and hindrance to the motion of the objects especially with respect to friction. |
| | CO3 | Explain the mechanical energy of bodies like PE, KE and conservation law of energy, the properties of simple harmonic motion. |
| **Course Outcomes** | CO4 | Explain gas laws, ideal gas equation, Isothermal and adiabatic processes, Specific heats, to study the laws of thermodynamics. Causes, consequences and methods to minimise noise pollution, explain beats, Doppler effect, Reverberation, echoes. |
| | CO5 | Explain certain properties of solids, liquids like elastic properties, viscosity and surface tension. Explain Ohm's law, to study Kirchoff's laws, to study the principle of Wheatstone's bridge and its application to meter bridge. To study the magnetic force and understand magnetic field. To compute magnetic field strength on axial and equatorial lines of a bar magnet. To familiarise with modern topics like photoelectric effect, optical fibres, superconductivity and nanotechnology. |

**Learning Outcomes**

**1.0 Concept of Units and dimensions**
    1.1 Explain the concept of Units, Physical quantity, Fundamental physical quantities and Derived physical quantities
    1.2 Define unit, fundamental units and derived units, State SI units with symbols
    1.3 State Multiples and submultiples in SI system, State Rules of writing S.I. units, State advantages of SI units
    1.4 Define Dimensions, Write Dimensional formulae of physical quantities
    1.5 List dimensional constants and dimensionless quantities
    1.6 State the principle of homogeneity of dimensions
    1.7 State the applications and limitations of dimensional analysis
    1.8 Errors in measurement, Absolute error, relative error, percentage error, significant figures
    1.9 Solve problems

**2.0 Concept of Elements of Vectors**
    2.1 Explain the concept of scalars, Vectors and give examples
    2.2 Represent vectors graphically, Classify the Vectors, Resolve the vectors
    2.3 Determine the resultant of a vector by component method, represent a vector in Space using unit vectors (i, j, k)
    2.4 State and explain triangle law, parallelogram law, and polygon law of addition of Vectors
    2.5 Define Dot product of two vectors with examples (Work done, Power), mention the Properties of dot product
    2.6 Define cross product of two vectors with examples (Torque, Linear velocity) Mention the properties of Cross product.

2.7    Solve the related numerical problems

**3.0    Concept of Dynamics**

3.1    Write the equations of motion in a straight line. Explain the acceleration due to Gravity.

3.2    Explain vertical motion of a body and derive expressions for a) Maximum Height, b) Time of ascent, c) time of descent, and d) time of flight

3.3    Derive height of a tower when a body projected vertically upwards from the top of a tower.

3.4    Explain projectile motion with examples

3.5    Explain horizontal projection and derive an expression for the path of a projectile in horizontal projection

3.6    Explain oblique projection and derive an expression for it. Derive formulae for a) Maximum Height b) time of ascent c) time of descent and d) time of flight e) Horizontal Range, f) Maximum range

3.7    Define force, momentum, angular displacement, angular velocity, angular acceleration, angular momentum, moment of inertia, torque

3.8    Solve the related numerical problems

**4.0    Concept of Friction**

4.1    Define friction and classify the types of friction.

4.2    Explain the concept of normal reaction.

4.3    State the laws of friction.

4.4    Define coefficients of friction, Angle of friction and angle of repose.

4.5    Derive expressions for acceleration of a body on a rough inclined plane.
        (Upwards and downwards)

4.6    List the advantages and disadvantages of friction.

4.7    Mention the methods of minimizing friction.

4.8    Explain why it is easy to pull a lawn roller than to push it.

4.9    Solve the related numerical problems.

**5.0    Concepts of Work, Power, and Energy**

5.1 Define the terms Work, Power and Energy. State SI units and dimensional formulae.

5.2 Define potential energy and give examples, derive an expression for potential energy.

5.3 Define Kinetic energy and give examples, derive an expression for kinetic energy.

5.4 State and derive Work-Energy theorem.

5.5 Derive the relation between Kinetic energy and momentum.

5.6 State the law of conservation of energy and verify it in the case of a freely falling body.

5.7 Solve the related numerical problems.

**6.0    Concepts of Simple harmonic motion**

6.1    Define Simple harmonic motion, Give examples, state the conditions.

6.2    Explanation of uniform circular motion of a particle is a combination of two Perpendicular S.H.M.s.

6.3    Derive expressions for displacement, velocity, acceleration, Frequency, Time period of a particle executing SHM.

6.4    Define phase of SHM.

6.5    Define Ideal simple pendulum and derive expression for time period of

simple pendulum.

6.6    State the laws of motion of simple pendulum.

6.7    Solve the related numerical problems.

**7.0    Concept of heat and thermodynamics**

7.1    Explain the concept of expansion of gases

7.2    State and explain Boyle's and Charles laws.

7.3    Define absolute zero temperature, absolute scale of temperature

7.4    Define ideal gas and distinguish from real gas

7.5    Derive Ideal gas equation. Define specific gas constant and universal gas constant, write S.I unit and dimensional formula. Calculate the value of R.

7.6    Explain why universal gas constant is same for all gases

7.7    State and explain isothermal process and adiabatic process

7.8    State first and second laws of thermodynamics and state applications

7.9    Define specific heats and molar specific heats of a gas, Derive $C_P - C_V = R$

7.10   Solve the relevant numerical problems

**8.0    Concept of Sound**

8.1   Concept of the sound, Wave motion. (Longitudinal and transverse wave)

8.2    Distinguish between musical sound and noise.

8.3    Explain noise pollution and state SI unit for intensity level of sound.

8.4    Explain causes, effects and methods of minimizing of noise pollution.

8.5    Explain the phenomenon of beats state the applications.

8.6    Define Doppler Effect, list the applications.

8.7   Define reverberation and reverberation time and write Sabine's formula.

8.8    Define and explain echoes state its applications.

8.9    State conditions of good auditorium.

8.10  Solve the related numerical problems.

**9.0    Concepts   of properties of matter**

9.1    Explain the terms elasticity, stress, strain and types of stress and strain.

9.2    State and explain Hooke's law.

9.3    Definitions of Modulus of elasticity, Young's modulus(Y), Bulk modulus (K),  Rigidity modulus ( n),Poisson's ratio ($\sigma$),

9.4    Define surface tension and give examples.

9.5    Explain Surface tension with reference to molecular theory.

9.6    Define angle of contact and capillarity and write formula for Surface Tension.

9.7    Explain the concept of viscosity, give examples, write Newton's formula.

9.8    Define co-efficient of viscosity and write its units and dimensional formula and State Poiseulle's equation for Co-efficient of viscosity.

9.9    Explain the effect of temperature on viscosity of liquids and gases.

9.10  Solve the related numerical problems.

**10.     Concepts of Electricity and Magnetism**

10.1   Explain Ohm's law in electricity and write the formula.

10.2  Define specific resistance, conductance and state their units.

10.3  Explain Kichoff's laws.

10.4  Describe Wheatstone's bridge with legible sketch.

10.5 Describe Meter Bridge for the determination of resistivity with a circuit diagram.

10.6 Explain the concept of magnetism. State the Coulomb's inverse square law of Magnetism.

10.7 Define magnetic field and magnetic lines of force and write the properties of magnetic lines of force.

10.8 Derive an expression for the moment of couple on a bar magnet placed in a uniform magnetic field.

10.9 Derive equations for Magnetic induction field strength at a point on the axial line and on the equatorial line of a bar magnet.

10.10 Solve the related numerical problems

## 11.0 Concepts of modern physics

11.1 State and explain Photo-electric effect and Write Einstein's photo electric Equation.

11.2 State laws of photo electric effect.

11.3 Explain the Working of photo electric cell, write its applications.

11.4 Recapitulation of refraction of light and its laws, critical angle, total Internal Reflection.

11.5 Explain the principle and working of Optical fiber, mention different types of Optical fiber, state the applications.

11.6 Define super conductor and super conductivity and mention examples.

11.7 State the properties of super conducting materials and list the applications.

11.8 Nanotechnology definition, nano materials, applications.


## COURSECONTENT

1. **Units and Dimensions**:
   Introduction, Physical quantity, Fundamental and Derived quantities, Fundamental and Derived units, SI units, Multiples and Sub multiples, Rules for writing S.I. units, Advantages of SI units. Dimensions and Dimensional formulae, Dimensional constants and Dimensionless quantities, Principle of homogeneity, Advantages and limitations of dimensional analysis, Errors in measurement, Absolute error, relative error, percentage error, significant figures, Problems.

2. **Elements of Vectors**:
   Scalars and Vectors, Types of vectors (Proper Vector, Null Vector, Unit Vector, Equal, Negative Vector, Like Vectors, Co-Initial Vectors, Co-planar Vectors and Position Vector).Addition of vectors, Representation of vectors, Resolution of vectors, Parallelogram, Triangle and Polygon laws of vectors, Subtraction of vectors, Dot and Cross products of vectors-Problems.

3. **Dynamics**
   Introduction-Concept of acceleration due to gravity-Equations of motion for a freely falling body and for a body thrown up vertically- Projectiles- Horizontal and Oblique projections- Expressions for maximum height, time of flight, range-Define force, momentum, angular displacement, angular velocity, angular acceleration, angular momentum, moment of inertia, torque–problems.

4. **Friction:**
Introduction to friction- Causes- Types of friction- Laws of friction- Angle of repose-Angle of friction- rough inclined plane- Advantages and disadvantages of friction-Methods of reducing friction–Problems.

5. **Work, Power and Energy:**
Work, Power and Energy- Definitions and explanation- potential energy-kinetic energy-Derivations of Potential and Kinetic energies-K.E and Momentum relation - Work-Energy theorem- Law of Conservation of energy-Problems.

6. **Simple Harmonic Motion:**
Introduction- Conditions of SHM- Definition- Examples- Expressions for displacement, velocity, acceleration, Time period, frequency and phase in SHM- Time period of a simple pendulum- Laws of simple pendulum-seconds pendulum-Problems.

7. **Heat and Thermodynamics:**
Expansion of Gases, Boyle's law, absolute scale of temperature- Charles laws- Ideal gas equation- Universal gas constant- Differences between gas constant(r) and universal gas constant(R),Isothermal and adiabatic processes, Laws of thermodynamics, Specific heats - molar specific heats of a gas -Different modes of transmission of heat ,laws of thermal conductivity, Coefficient of thermal conductivity-Problems.

8. **Sound:**
Sound- Nature of sound- Types of wave motion -musical sound and noise-Noise pollution – Causes &effects- Methods of reducing noise pollution-Beats- Doppler effect- Echo- Reverberation-Reverberation time-Sabine 's formula-Conditions of good auditorium- Problems.

9. **Properties of matter**
Definition of Elasticity –Definition of stress and strain -the units and dimensional formulae for stress and strain-The Hooke's law- Definitions of Modulus of elasticity, Young's modulus(Y), Bulk modulus(K), Rigidity modulus ( n),Poisson's ratio ($\sigma$), relation between Y, K, n and $\sigma$(equations only no derivation)
Definition of surface tension-Explanation of  Surface tension with reference to molecular theory - Definition of angle of contact -Definition of capillarity -The formula for surface tension based on capillarity - Explanation of  concept of Viscosity - Examples for surface tension and Viscosity - Newton's formula for viscous force- Definition of co-efficient of viscosity- The effect of temperature on viscosity of liquids and gases - Poiseuille's equation for Co-efficient of viscosity- The related numerical problems.

10. **Electricity & Magnetism:**
Ohm's law and  explanation, Specific resistance, Kirchoff's laws, Wheatstone's bridge, Meter bridge, Coulomb's inverse square law, magnetic field, magnetic lines of force, magnetic induction field strength-magnetic induction field strength at a point on the axial line - magnetic

induction field strength at a point on the equatorial line–problems.

## 11.  Modern Physics;

Photoelectric effect –Einstein's photoelectric equation-laws of photoelectric effect-photoelectric cell–Applications of photo electric effect- Total internal reflection- fiber optics- -principle and working of an optical fiber-types of optical fibers - Applications of optical fibers- superconductivity–applications- Nanotechnology definition, nano materials, applications

**REFERENCEBOOKS**

1. Telugu Academy ( English version )                Intermediate physics Volume-I & 2
2. Dr. S. L. Guptha and Sanjeev Guptha        Unified physics Volume 1,2,3 and 4
3. Resnick& Holiday                Text book of physics Volume I
4. Dhanpath Roy                        Text book of applied physics

5. D.A Hill                        Fiber  optics
6. XI & XII Standard                NCERT Text Books

➢    **Model Blue Print with Weightage for Blooms category and questions for chapter and Cos mapped**

| S. No | Unit Title/Chapter | No of Periods | Weightage of marks | Marks wise distribution of Weightage | | | | Question wise distribution of Weightage | | | | Mapped with CO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | R | U | Ap | An | R | U | Ap | An | |
| 1 | Units and Dimensions | 08 | 03 | 3 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | CO1 |
| 2 | Elements of Vectors | 12 | 11 | 3 | 8 | 0 | 0 | 1 | 1 | 0 | 0 | CO1 |
| 3 | Dynamics | 12 | 11 | 3 | 8 | 0 | 0 | 1 | 1 | 0 | * | CO2 |
| 4 | Friction | 10 | 11 | 3 | 0 | 8 | 0 | 1 | 0 | 1 | 0 | CO2 |
| 5 | Work, Power and Energy | 12 | 11 | 3 | 8 | 0 | 0 | 1 | 1 | 0 | 0 | CO3 |
| 6 | Simple harmonic motion | 12 | 11 | 3 | 8 | 0 | 0 | 1 | 1 | 0 | * | CO3 |
| 7 | Heat and Thermodynamics | 12 | 11 | 0 | 8 | 3 | 0 | 0 | 1 | 1 | * | CO4 |
| 8 | Sound | 10 | 11 | 0 | 8 | 3 | 0 | 0 | 1 | 1 | 0 | CO4 |
| 9 | Properties of matter | 10 | 08 | 0 | 8 | 0 | 0 | 0 | 1 | 0 | 0 | CO5 |
| 10 | Electricity and Magnetism | 12 | 14 | 6 | 0 | 8 | 0 | 2 | 0 | 1 | 0 | CO5 |

| 11 | Modern physics | 10 | 08 | 0 | 8 | 0 | 0 | 0 | 1 | 0 | 0 | CO5 |
|----|----------------|----|----|---|---|----|---|---|---|---|------|-----|
| | **Total** | **120** | **110** | **24** | **64** | **22** | **0** | **8** | **8** | **4** | ***10** | |

**\*One question of HOTs for 10 marks from any of the unit title 3 or 6 or 7**

➢ **Table specifying the scope of syllabus to be covered for Unit Tests**

| Unit Test | Learning outcomes to be covered |
|-----------|--------------------------------|
| Unit Test – 1 | From 1.1 to 4.9 |
| Unit Test – 2 | From 5.1 to 7.10 |
| Unit Test – 3 | From 8.1 to 11.8 |

# ENGINEERING CHEMISTRY AND ENVIRONMENTAL STUDIES

| Course code | Course Title | No. of Periods per week | Total No. of Periods | Marks for FA | Marks for SA |
|---|---|---|---|---|---|
| M-104 | Engineering Chemistry and Environmental Studies | 4 | 120 | 20 | 80 |

| S.No | Unit Title/Chapter | No of Periods | COs Mapped |
|---|---|---|---|
| 1 | Fundamentals of Chemistry | 18 | CO1 |
| 2 | Solutions | 10 | CO1 |
| 3 | Acids and bases | 10 | CO1 |
| 4 | Principles of Metallurgy | 8 | CO1 |
| 5 | Electrochemistry | 16 | CO2 |
| 6 | Corrosion | 8 | CO2 |
| 7 | Water Treatment | 10 | CO3 |
| 8 | Polymers | 12 | CO4 |
| 9 | Fuels | 6 | CO4 |
| 10 | Chemistry in daily life | 6 | CO4 |
| 11 | Environmental Studies | 16 | CO5 |
| | **Total** | **120** | |

➢ **Course Objectives**

| Course Title: Engineering Chemistry & Environmental Studies | |
|---|---|
| **Course Objectives** | 1. To familiarize with the concepts of chemistry involved in the process of various Engineering Industrial Applications. <br> 2. To know the various natural and man-made environmental issues and concerns with an interdisciplinary approach that include physical, chemical, biological and socio cultural aspects of environment. <br> 3. To reinforce theoretical concepts by conducting relevant experiments/exercises |

➢ **Course outcomes**

| Course Outcomes | CO1 | Explain Bohr`s atomic model, chemical bonding, mole concept, acids and bases, $P^H$ metallurgical process and alloys |
| | CO2 | Explain electrolysis, Galvanic cell, emf and corrosion |
| | CO3 | Explain the chemistry involved in the treatment of water by advanced method |
| | CO4 | Synthesise of Plastics, rubber and applications of fuel chemical compounds used in our daily life. |
| | CO5 | Explain the causes, effects and control methods of air and water pollution and measures to protect the environment |

➢ **Model Blue Print with Weightage for Blooms category and questions for each chapter and COs mapped**

| S.No | Unit Title/Chapter | No of Periods | Weight age of marks | Marks wise distribution of Weightage | | | | Question wise distribution of Weightage | | | | Mapped with CO |
|------|------|------|------|---|---|---|---|---|---|---|---|------|
| | | | | R | U | Ap | An | R | U | Ap | An | |
| 1 | Fundamentals of Chemistry | 18 | 19 | 8 | 8 | 3 | | 1 | 1 | 1 | | CO1 |
| 2 | Solutions | 10 | 11 | 0 | 0 | 8 | 3 | | | 1 | 1 | CO1 |
| 3 | Acids and bases | 10 | 11 | 0 | 8 | 0 | 3 | | 1 | | 1 | CO1 |
| 4 | Principles of Metallurgy | 8 | 8 | 8 | 0 | 0 | | 1 | | | | CO1 |
| 5 | Electrochemistry | 16 | 11 | 8 | 3 | 0 | | 1 | 1 | | * | CO2 |
| 6 | Corrosion | 8 | 8 | 0 | 8 | 0 | | | 1 | | | CO2 |
| 7 | Water Treatment | 10 | 11 | 8 | 3 | 0 | | 1 | 1 | | | CO3 |
| 8 | Polymers | 12 | 11 | 3 | 8 | 0 | | 1 | 1 | | * | CO4 |
| 9 | Fuels | 6 | 3 | 3 | 0 | 0 | | 1 | | | | CO4 |
| 10 | Chemistry in daily life | 6 | 3 | 0 | 0 | 3 | | | | 1 | | CO4 |
| 11 | Environmental Studies | 16 | 14 | 3 | 11 | 0 | | 1 | 2 | | | CO5 |
| **Total** | | **120** | **110** | **12** | **6** | **6** | **6** | **20** | **35** | **5** | ***10** | |

**\*One question of HOTs for 10 marks from any of the unit title 5 or 8**

**Upon completion of the course the student shall be able to learn out**

## ENGINEERINGCHEMISTRY AND ENVIRONMENTAL STUDIES

### 1.0 Atomic structure

1.1   Explain the charge, mass of fundamental particles of an atom (electron, proton and neutron) and the concept of atomic number and mass number.

1.2   State the Postulates of Bohr's atomic theory and its limitations.

1.3    Explain the significance of four Quantum numbers.

1.4   Explain 1.Aufbau principle, 2 Pauli's exclusion principle 3 Hund's rule.

1.5   Define Orbital of an atom and draw the shapes of s, p and d- Orbitals.

1.6   Write the electronic configuration of elements up to atomic number 30

1.7   Explain the significance of chemical bonding

1.8   Explain the Postulates of Electronic theory of valency

1.9   Define and explain Ionic and Covalent bonds with examples of NaCl , MgO, $*H_2, *O_2$ and $*N_2$.       (* Lewis dot method)

1.10  List out the Properties of Ionic compounds and covalent compounds and distinguish between their properties.

1.11  Structures of ionic solids-define a) Unit cell b) co-ordination number and the structures of NaCl and CsCl unit cells.

### 2.0   Solutions

2.1   Define the terms 1.Solution, 2.Solute and 3.Solvent

2.2   Classify solutions based on physical state and solubility

2.3   Define mole and problems on mole concept.

2.4   Define the terms 1. Atomic weight, 2.Molecular weight and 3. Equivalent weight and calculate Molecular weight and Equivalent weight of  the given acids.$(HCl, H_2SO_4, H_3PO_4)$Bases (NaOH, $Ca(OH)_2$, $Al(OH)_3$ ) and Salts (NaCl, $Na_2CO_3$, $CaCO_3$)

2.5   Define molarity and normality and numerical problems on molarity and normality

   a) Calculate the Molarity or Normality if weight of solute and volume of solution are given

   b) Calculate the weight of solute if Molarity or normality with volume of solution are given

   c) Problems on dilution to convert high concentrated solutions to low concentrated Solutions.

### 3.0   Acids and bases

3.1   Explain Arrhenius theory of Acids and Bases and give the limitations of Arrhenius theory of Acids and Bases.

3.2   Explain Bronsted–Lowry theory of acids and bases and  give the limitations of Bronsted–Lowry theory of acids and bases.

3.3   Explain Lewis theory of acids and bases and give the limitations of Lewis theory of acids and bases.

3.4   Explain the Ionic product of water

3.5   Define pH and explain $P^H$ scale and solve the Numerical problems on pH(Strong Acids and Bases)

3.6   Define and explain buffer solution and give the examples of buffer solutions.

3.7    State the application of buffer solutions.

### 4.0   Principles of Metallurgy

4.1   List out the Characteristics of Metals and non-metals

4.2   Distinguish between Metals and Non-metals

4.3   Define the terms 1.Mineral, 2.Ore, 3. Gangue, 4.Flux5.Slag

4.4 Describe the methods of concentration of Ore; 1.Handpicking, 2.Levigation and 3. Froth Floatation

4.5 Describe the methods involved in extraction of crude metal- Roasting, Calcination and Smelting.

4.6 Explain the purification of Copper by Electrolytic Refining

4.7 Define an Alloy and Write the composition and uses of the following alloys. 1. Brass 2. Germen silver 3. Nichrome.

**5.0 Electrochemistry**

5.1 Define the terms1. Conductor 2. Semiconductor 3.Insulator, 4.Electrolyte5.Non–electrolyte. Give two examples each.

5.2 Distinguish between metallic conduction and Electrolytic conduction

5.3 Explain electrolysis by taking example fused NaCl

5.4 Explain Faraday's laws of electrolysis

5.5 Define 1.Chemical equivalent (E) 2.Electrochemicalequivalent (e) and their relation.

5.6 Solve the Numerical problems on Faraday's laws of electrolysis and applications of electrolysis (Electro plating)

5.7 Define Galvanic cell and explain the construction and working of Galvanic cell.

5.8 Distinguish between electrolytic cell and galvanic cell

5.9 Explain the electrode potentials and standard electrode potentials

5.10 Explain the electrochemical series and its significance

5.11 Explain the emf of a cell and solve the numerical problems on emf of the cell based on standard electrode potentials.

**6.0 Corrosion**

6.1 Define the term corrosion.

6.2 state the Factors influencing the rate of corrosion

6.3 Describe the formation of a) composition cell b) stress cell c)concentration cell during corrosion.

6.4 Define rusting of iron and explain the mechanism of rusting of iron.

6.5 Explain the methods of prevention of corrosion
   a) Protective coatings (anodic and cathodic coatings)
   b) Cathodic protection (Sacrificial anode process and Impressed–voltage process)

**7. 0 Water Treatment**

7.1 Define soft water and hard water with respect to soap action.

7.2 Define and classify the hardness of water.

7.3 List out the salts that causing hardness of water (with Formulae)

7.4 State the disadvantages of using hard water in industries.

7.5 Define Degree of hardness and units of hardness (mg/L) or( ppm).

7.6 Explain the methods of softening of hard water: a) Ion-exchange process, b) Permutit process or zeolite process

7.7 State the essential qualities of drinking water.

7.8 Chemistry involved in treatment of water (Coagulation, Chlorination, deflouridation)

7.9 Explain Osmosis and Reverse Osmosis with examples.

7.10 State the applications of Reverse Osmosis.

**8.0 Polymers**

8.1 Explain the concept of polymerisation

8.2 Describe the methods of polymerization a) addition polymerization of

ethylene b) condensation polymerization of Bakalite (Only flow chart)

8.3 Define thermoplastics and thermosetting plastics with examples.

8.4 Distinguish between thermo plastics and thermosetting plastics

8.5 List the Characteristics of plastics and state the disadvantages of using plastics.

8.6 State the advantages of plastics over traditional materials.

8.7 Explain the methods of preparation and uses of the following plastics:
1. PVC, 2.Teflon, 3. Polystyrene 4. Nylon 6,6

8.8 Explain processing of Natural rubber and write the structural formula of Natural rubber.

8.9 List the Characteristics of raw rubber

8.10 Define and explain Vulcanization and List out the Characteristics of Vulcanized rubber.

8.11 Define the term Elastomer and describe the preparation and uses of the following synthetic rubbers a) Buna-s and b)Neoprene rubber.

**9.0 Fuels**

9.1 Define the term fuel

9.2 Classify the fuels based on physical state and based on occurrence.

9.3 List the characteristics of good fuel.

9.4 State the composition and uses of gaseous fuels.
a)water gas b) producer gas, c) natural gas, d) Coal gas, e)Biogas.

**10.0 Chemistry in daily life**

10.1 Give the basic chemical composition, applications, health aspects and pollution impacts of a) soaps, and detergents b) vinegar c) Insect repellents d) activated charcoal e) Soft drinks

**11.0 ENVIRONMENTALSTUDIES**

11.1 Define the term environment and explain the scope and importance of environmental studies

11.2 Define the segments of environment 1).Lithosphere, 2).Hydrosphere, 3).Atmosphere, 4).Biosphere,

11.3 Define the following terms 1)Pollutant, 2).Pollution, 3).Contaminant, 4)receptor, 5)sink, 6) particulates, 7)dissolved oxygen (DO), 8)Threshold limit value (TLV), 9).BOD,10).COD 11) eco system12)Producers13)Consumers 14) Decomposers with examples

11.4 State the renewable and non-renewable energy sources with examples.

11.5 Explain biodiversity and threats to biodiversity

11.6 Define air pollution and classify the air pollutants-based on origin and physical state of matter.

11.7 Explain the causes, effects of air pollution on human beings, plants and animals and control methods of air pollution.

11.8 State the uses of forest resources.

11.9 Explain causes and effects of deforestation

11.10 Explain the causes and effects of the following
1.) Greenhouse effect, 2) Ozone layer depletion and 3) Acid rain

11.11 Define Water pollution, explain the causes, effects and control methods of Water pollution.

**COURSE CONTENT**

**ENGINEERING CHEMISTRY AND ENVIRONMENTAL STUDIES**

1. **Fundamentals of Chemistry**

   **Atomic Structure:** Introduction - Fundamental particles – Bohr's theory – Quantum numbers – Aufbau principle - Hund's rule - Pauli's exclusion Principle- Orbitals, shapes of s, p and d orbitals - Electronic configurations of elements

   **Chemical Bonding:** Introduction – types of chemical bonds – Ionic and covalent bond with examples–Properties of Ionic and Covalent compounds-structures of ionic crystals (NaCl and CsCl).

2. **Solutions**

   Introduction of concentration methods – mole concept, molarity and normality – Numerical problems on mole, molarity and normality.

3. **Acids and Bases**

   Introduction – Theories of acids and bases and limitations – Arrhenius theory-Bronsted –Lowry theory – Lewis acid base theory – Ionic product of water- pH related numerical problems–Buffer solutions, action of buffer and its applications.

4. **Principles of Metallurgy**

   Characteristics of Metals and non-metals –Distinguish between Metals and Non-metals, Define the terms i) Metallurgy ii) ore iii) Gangue iv) flux v) Slag - Concentration of Ore –Hand picking, Levigation, Froth floatation – Methods of Extraction of crude Metal – Roasting, Calcination, Smelting – Alloys – Composition and uses of brass, German silver and nichrome.

5. **Electrochemistry**

   Conductors, semiconductors, insulators, electrolytes and non-electrolytes – electrolysis – Faraday's laws of electrolysis-application of electrolysis(electroplating) -numerical problems on Faraday's laws – Galvanic cell – standard electrode potential – electrochemical series–emf and numerical problems on emf of a cell .

6. **Corrosion**

   Introduction - factors influencing corrosion - composition, stress and concentration cells–rusting of iron and its mechanism – prevention of corrosion by coating methods, cathodic protection methods.

7. **Water technology**

   Introduction–soft and hard water–causes of hardness–types of hardness –disadvantages of hard water – degree of hardness (ppm and mg/lit) – softening methods – permutit process – ion exchange process– qualities of drinking water –Chemistry involved in treatment of water (Coagulation, Chlorination, defluoridation ) - Osmosis, Reverse Osmosis –Applications of Reverse osmosis.

8. **Polymers**

   Introduction – polymerization – types of polymerization – addition, condensation with examples – plastics – types of plastics – advantages of plastics over traditional materials-Disadvantages of using plastics – Preparation and uses of the following plastics i).PVC ii) Teflon iii) Polystyrene iv) .Nylonn 6,6 –Processing of natural rubber - Vulcanization – Elastomers-Preparation and applications of Buna-s, Neoprene rubbers.

9. **Fuels**

   Definition and classification of fuels–characteristics of good fuel-composition and uses of gaseous fuels.

10. **Chemistry in daily life**

    Basic composition, applications, health aspects and pollution impacts of soaps and detergents, vinegar, insect repellents, soft drinks, activated charcoal.

11. **ENVIRONMENTAL STUDIES**

    Introduction– environment –scope and importance of environmental studies – important terms related to environment– renewable and non-renewable energy sources–Concept of ecosystem – Biotic components –Forest resources – Deforestation -Biodiversity and its threats-Air pollution – causes-effects– Global environmental issues – control measures – Water pollution – causes – effects – control measures.

**REFERENCEBOOKS**

1. Telugu Academy     Intermediate chemistry Vol 1&2
2. Jain & Jain           Engineering Chemistry
3. O.P. Agarwal,          Hi- Tech. Engineering Chemistry
4. Sharma                  Engineering Chemistry
5. A.K. De                  Engineering Chemistry

**Table specifying the scope of syllabus to be covered for unit test 1, unit test 2 and unit test 3**

| Unit Test | Learning outcomes to be covered |
|---|---|
| Unit Test - 1 | From 1.1 to 3.7 |
| Unit Test - 2 | From 4.1 to 7.10 |
| Unit Test - 3 | From 8.1 to 11.11 |

# ENGINEERING MECHANICS

| Course Title | Course Code | Periods/Week | Periods per year |
|---|---|---|---|
| Engineering Mechanics | M-105 | 04 | 120 |

## TIME SCHEDULE

| S No. | Chapter/Unit Title | Periods | Weightage of Marks | Short Answer Questions (3M) | Essay Type Questions (8M) | Essay Type Question (10 M ) |
|---|---|---|---|---|---|---|
| 1 | Statics | 20 | 14 | 2 | 1 | |
| 2 | Friction | 20 | 14 | 2 | 1 | |
| 3 | Geometrical Properties of sections | 30 | 14 | 2 | 1 | 1 |
| 4 | Dynamics | 20 | 14 | 2 | 1 | |
| 5 | Simple Mechanisms & Machines | 30 | 14 | 2 | 1 | |
| | Total | 120 | 70+10 | 10 | 5 | 1 |

**Note:  10 Marks higher order question may be given from Chapter -1 or 2 or 3 or 4 or 5.**

## Course Objectives and Course Outcomes

| Course Objectives | **Upon completion of the course the student shall be able to** Understand the basic principles of statics and dynamics of rigid bodies. Calculate the reactive forces and motion characteristics for given conditions Understand the working of simple mechanisms and machines. | |
|---|---|---|
| **Course Outcomes** | CO1 | M-105.1 | Explain the basic concepts of force, moment, composition and resolution of forces, equilibrium, resultant of forces and moments in coplanar force systems and applying them to analyse the real time problems |
| | CO2 | M-105.2 | Apply the Newton's laws of motion to the rectilinear and curvilinear motion to find the motion characteristics. |
| | CO3 | M-105.3 | Apply the various principles like, Work-Energy principle and Impulse – Momentum principle to solve the kinetic problems of particles |
| | CO4 | M-105.4 | Illustrate working principles of simple machines and functioning of simple mechanisms used in day to day needs. |

| | CO5 | M-105.5 | Calculate various geometric properties of areas like centroid, moment of inertia and apply them to solve the engineering problems |
|---|---|---|---|

## MODEL BLUE PRINT OF QUESTION PAPER

| S. No | Chapter Name | Periods Allocated | Weightage Allocated | Marks Wise Distribution of Weightage | | | | Question Wise Distribution of Weightage | | | | CO's Mapped |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | R | U | Ap | An | R | U | Ap | An | |
| 1 | Statics | 20 | 14 | 3 | 3 | 8 | - | 1 | 1 | 1 | - | CO1 |
| 2 | Friction | 20 | 14 | 3 | 3 | 8 | - | 1 | 1 | 1 | - | CO1 |
| 3 | Geometrical properties of Sections | 30 | 14 | 3 | 3 | 8 | - | 1 | 1 | 1 | - | CO5 |
| 4 | Dynamics | 20 | 14 | 3 | 3 | 8 | - | 1 | 1 | 1 | - | CO2, CO3 |
| 5 | Simple Mechanisms & Machines | 30 | 24 | 3 | 3 | 8 | 10 | 1 | 1 | 1 | 1 | CO4 |
| **Total** | | **120** | **80** | **15** | **15** | **40** | **10** | **05** | **05** | **05** | **1** | |

R-Remembering;     U-Understanding;     Ap-Applying;     An- Analylising

**Note:  10 Marks higher order question may be given from Chapter -1 or 2 or 3 or 4 or 5. (Here it is taken from the Chapter – 5)**

### LEARNING OUTCOMES
Upon completion of the course the student shall be able to

**1.0     Statics**
1.1     Explain the importance of engineering mechanics in real world
1.2     Explain the concept of force
1.3     Classify the system of forces.
1.4     Explain the system of forces a) Co-planar and Non-coplanar, b) Parallel and Non-Parallel, c) Like and Unlike,   d) Concurrent and Non-concurrent
1.5     Explain Composition and Resolution of force and resultant of concurrent coplanar forces.
1.6     Explain the concept of equilibrium.
1.7     State (a) parallelogram law (b) triangle law (c) polygon law of forces (d) Lames' theorem.

1.8    Problems on parallelogram law of forces.
1.9    Solve the problems on involving concurrent coplanar forces.
1.10   Explain moment of force and couple.
1.11   State the condition of equilibrium of a body acted upon by co-planar forces
1.12   State Varignon's theorem.

**2.0    Friction**
2.1    Explain the concept of friction
2.2    State the laws of friction
2.3    Define i) angle of friction ii) angle of repose
2.4    Identify the machine members in which friction is desirable.
2.5    Resolve the forces acting on bodies moving on horizontal plane.
2.6     Resolve the forces acting on bodies moving up on an inclined plane.  Force applied (a) parallel to the plane (b) Parallel to the base (c) Inclined to the plane.
2.7    Resolve the forces acting on bodies moving down on an inclined plane.  Force applied (a) parallel to the plane (b) Parallel to the base    (c) Inclined to the plane.
2.8    Solve the related numerical problems of the above cases.

**3.0    Geometric Properties of sections**
3.1    Define the terms i) centre of gravity ii) centroid.
3.2    Write the differences among centre of gravity and centroid
3.3    State the need for finding the centroid and centre of gravity for various engineering applications.
3.4    Explain the method of determining the centroid by 'Method of moments'
3.5    Determine the position of centroid of standard sections like -T, L, I, Channel section, Z – Section.
3.6    Explain the meaning of the terms i) moment of Inertia ii) Polar moment of inertia iii) Radius of gyration.
3.7    State the necessity of finding Moment of Inertia for various engineering applications
3.8    State and derive (a) Parallel axes theorem (b) Perpendicular axes theorem
3.9    Determine Moment of Inertia and Radius of gyration for rectangular geometrical sections.
3.10   Determine MI of standard sections by applying parallel axes theorem

**4.0    Dynamics**
4.1   Define the terms ii) Kinematics ii) Kinetics
4.2   Classify the motion.
4.3   Define the terms i) displacement ii) velocity iii) acceleration and write equations of motion.
4.4   State the Newton's Laws of motion
4.5   Solve the problems related to the rectilinear motion of a particle
4.6   Explain the rotary motion of particle
4.7   Define the law of conservation of energy
4.8   Explain the Work-Energy principle
4.9   Define the law of conservation of momentum
4.10  Explain the Impulse –momentum equation
4.11  Solve the problems using the above principles.
4.12  Define i) centripetal force ii) centrifugal force.
4.13  Differentiate centripetal force from centrifugal force.
4.14   Solve the problems using the above principles.

**5.0    Simple Mechanisms & Machines**

5.1    Define the terms i) kinematic link ii )kinematic pair iii)Kinematic chain iv) Mechanism v) Machine  vi) Structure  vii) inversion of mechanism.

5.2    Write the classification of kinematic pairs on different criteria

5.3    Explain with legible sketches the inversions of quadric cycle chain only

5.4    Define the important terms of simple machines
a) Machine, b) Mechanical Advantage, c) Velocity Ratio, d) Efficiency
e) Ideal Machine  f) Ideal Effort   g) Ideal Load   h) Reversibility of a machine

5.5    Illustrate the use of three classes of simple lever.

5.6    Explain how an inclined plane act as a simple machine to reduce the effort in lifting loads.

5.7    Derive expression for velocity ratio for i) wheel & axle   ii) Weston Differential pulley block iii) pulleys   iv) Worm & Worm wheel   v) winch crabs    vi) screw jack vi) rack & pinion.

5.8    Calculate the efficiency of a given machine.

5.9    Calculate the effort required to raise and lower the load on screw jack under given conditions.

5.10   Explain the law of machine.

5.11   State the conditions for self-locking.

5.12   State the conditions for reversibility.

5.13   Calculate effort lost in friction and load equivalent of friction.

5.14   Evaluate the conditions for i) maximum mechanical advantage   iii) maximum efficiency of a machine.

**COURSE CONTENTS:**

**1.0    Statics**

Importance of engineering mechanics in engineering - Definition of force and its specifications  - System of forces - Composition and Resolution of force - Equilibrium and Equilibrant, resultant - Statement of parallelogram law of forces, triangle law of forces, polygon law of forces and Lames' theorem -  Numerical problems related to concurrent coplanar forces.

Moment of force and moment of a couple - Condition for equilibrium of a rigid body subjected to number of coplanar forces - Varignon's Principle.

**2.0    Friction**

Definition of static friction, dynamic friction - laws of solid and dynamic friction - angle of friction and angle of repose - Resolution of forces considering friction when a body moves on horizontal plane and inclined plane when Force applied (a) parallel        to the plane   (b)Parallel to the base     (c) Inclined to the plane.- Numerical examples on the above cases.

**3.0    Geometric Properties of Sections**

Definition and explanation of the terms centre of gravity and centroid - Centroid of square, rectangle, triangle, semi-circle and trapezium    (formulae only without derivations) - Centre  of gravity of composite sections by analytical method only (T-

Section, L-Section I-section, Z-section and channel section) - Moment of Inertia and Radius of Gyration - i) Parallel axes theorem,
ii) Perpendicular axes theorem - Calculation of Moment of Inertia  a) I – Section, b) Channel Section, c) T – Section  d) L – Section (Equal & unequal lengths),  e) Z - section .

## 4.0    Dynamics

Definition of Kinematics and Kinetics - Classification of motion - Definition of displacement, velocity and acceleration – Equations of motion - Newton's Laws of motion (without derivation) - Solving the problems related to the rectilinear motion of a particle - Law of conservation of energy - Law of conservation of momentum - Work-Energy principle - Impulse–momentum equation  - Solving the  problems using the above principles - Definition of centripetal and centrifugal force and differences between them- Numerical problems.

## 5.0    Simple Mechanisms & Machines

Define the terms kinematic link, kinematic pair, Kinematic Chain, Mechanism, Machine, Structure and inversion - classification of kinematic pairs on different criteria – nature of contact, relative motion and type of closure – Explain inversions of Quadric cycle chain - Definition of simple machine, and uses of simple machine, levers and inclined plane  -Fundamental terms like mechanical advantage, velocity ratio and efficiency - Expressions for VR in case of three systems of pulleys, Weston Differential pulley block,  Worm and Worm wheel, Rack and pinion, Winch crabs, &Screw jack - Conditions for reversibility and self locking - Law of Simple Machine - Effort lost in friction, Load Equivalent of Friction Maximum Mechanical Advantage and Maximum Efficiency.

## REFERENCE BOOKS:

| 1 | Engineering Mechanics | Singer | B.S.Publications |
|---|---|---|---|
| 2. | Engineering Mechanics | K.L. Kumar | TMH |
| 3 | Engineering Mechanics | Timoshenko | MGH |
| 4 | Mechanics of Solids | S.S. BHAVIKATTI | New Age |
| 5 | Theory of Machines | S.S. RATTAN | TMH |

## WORKSHOP TECHNOLOGY

| Course Title | Course Code | Periods per Week | Periods per Year |
|---|---|---|---|
| Workshop Technology | M-106 | 04 | 120 |

## TIME SCHEDULE

| S. No. | Chapter/Unit Title | Periods | Weightage of Marks | Short Answer Questions (3M) | Essay Type Questions (8M) | Essay Type Question (10M) |
|---|---|---|---|---|---|---|
| 1 | Basic Workshop tools & operations | | | | | 01 |
| | (1) Carpentry | 20 | 25 | 03 | 02 | |
| | (2) Fitting | 25 | | | | |
| | (3) Forging | 15 | | | | |
| | (4) Sheet metal | 12 | | | | |
| 2 | Drilling | 10 | 14 | 02 | 01 | |
| 3 | Foundry | 22 | 17 | 03 | 01 | |
| 4 | Mechanical working of metals | 16 | 14 | 02 | 01 | |
| | **Total** | **120** | **70+10** | **10** | **05** | **01** |

**Note: 10 Marks higher order question may be given from Chapter -1 or 2 or 3 or 4.**

## Course Objectives and Course Outcomes

| COURSE OBJECTIVES | Upon completion of the course the student shall be able to<br>1. Understand the use of basic workshop tools and its operations<br>2. Know the basic workshop operations such as carpentry, fitting, forging, sheet metal, drilling, Foundry and Mechanical working of metals | | |
|---|---|---|---|
| **COURSE OUTCOMES** | CO1 | M-106.1 | Categorise basic workshop tools , i.e., marking and measuring tools, cutting tools etc.,<br>Explain different operations used in carpentry, fitting, forging and sheet metal. |
| | C02 | M-106.2 | Describe the process like marking, sawing, chiselling in wood working process and fitting, upsetting drawing down and punching in forging, shearing, bending, drawing, squeezing in sheet metal |
| | C03 | M-106.3 | Describe the functions of sensitive and radial drilling machines and operations on drilling machine |

| | C04 | M-106.4 | Describe the sequence of pattern making operations. Describe casting and special casting processes |
| | C05 | M-106.5 | Describe the hot working and cold working processes |

**Blue Print of question Paper**

| S. No | Chapter Name | Periods Allocated | Weightage Allocated | Marks Wise Distribution of Weightage | | | | Question Wise Distribution of Weightage | | | | CO's Mapped |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | R | U | Ap | An | R | U | Ap | An | |
| 1 | Basic Workshop tools & operations (1) Carpentry (2) Fitting (3)Forging (4) Sheet metal | 20 25 15 12 | 35 | 06 | 03 | 16 | 10 | 2 | 1 | 2 | 1 | CO1, CO3, CO5 |
| 2 | Drilling | 10 | 14 | 03 | 03 | 08 | | 01 | 01 | 01 | | CO1, CO3 |
| 3 | Foundry | 22 | 17 | 06 | 03 | 08 | | 02 | 01 | 01 | | CO3 |
| 4 | Mechanical working of metals | 16 | **14** | 03 | 03 | 08 | | 01 | 01 | 01 | | CO1, CO2, CO5 |
| | TOTAL | 120 | 80 | 18 | 12 | 40 | 10 | 06 | 04 | 05 | 1 | |

R-Remembering;    U-Understanding;    Ap-Applying;    An- Analylising

**Note:  10 Marks higher order question may be given from Chapter -1 or 2 or 3 or 4 (Here it is taken from the chapter - 1.**

**Learning Outcomes**
Upon completion of the course the student shall be able to

**1.0    Basic workshop tools and its operation**
a.  State the importance of workshop processes.
b.  List the various workshop processes and explain briefly about each.
1.1   **Carpentry**
1.1.1. Identify various carpentry tools.
1.1.2. Distinguish between marking tools, measuring tools and cutting tools.
1.1.3. List work holding devices.
1.1.4. Explain wood working processes viz., sawing, chiselling and planning.

1.1.5. Explain the use of carpentry joints such as lap joint, dovetail joint, mortise and tenon joint with legible sketch
1.1.6. Explain the working of wood working machines.

1.2 **Fitting**
1.2.1. List various fitting tools.
1.2.2. Distinguish between marking and measuring tools.
1.2.3. List cutting tools.
1.2.4. List various work holding devices.
1.2.5. List various checking and measuring instruments.
1.2.6. Explain fitting operations such as marking, sawing, chipping, filing, grinding, drilling and tapping with legible sketch.

1.3 **Forging**
1.3.1. List various tools used in black-smithy.
1.3.2. List equipment used in a forging shop.
1.3.3. Explain the important smithy operations
1.3.4. Explain the working principle of machine forging
1.3.5. Explain machine forging operations such as upsetting, drawing down and punching with legible sketch
1.3.6. Explain the working principle of forging press with legible sketch.
1.3.7. List the forging defects

1.4 **Sheet Metal**
1.4.1. List various marking tools in sheet metal work
1.4.2. List various stakes
1.4.3. List various measuring tools used in sheet metal work
1.4.4. List various sheet metal joints.
1.4.5. Describe sheet metal operations such as shearing, bending drawing and squeezing
1.4.6. Differentiate between riveting, soldering & brazing

**2.0 Drilling**
2.1. State the working principle of drilling
2.2. List two types of drilling machines
2.3. Describe the Sensitive drilling machine with line diagram
2.4. Describe the radial drilling machine with line digram
2.5. Mention the specifications of drilling machine
2.6. Explain the nomenclature of the drill bit
2.7. Sketch the geometry of twist drill
2.8. List the functions of twist drill elements
2.9. List different operations on drilling machine

**3.0 Foundry**
3.1. State
(a) Any six advantages of casting over other processes
(b) the six limitations of casting processes
3.2. List hand moulding tools
3.3 Mention the various properties of good moulding sand and types of moulding sands
3.4 List (a) ingredients in foundry sand
(b) any six types of patterns
3.5 Explain the procedure of pattern making

3.6. Identify colour codes

3.7. List the different moulding processes

3.8. State the need of core and list different types of cores

3.9. Describe the casting process with legible sketch and.
Identify various a casting defects

3.10 Explain

  (a) principle and application of die casting
  (b) principle and application of hot chamber and cold chamber
  (c) principle and application of centrifugal casting
  (d) principle and application of $CO_2$ process
  (e) principle and application of investment casting

## 4.0 Mechanical working of metals

4.1.    Define Mechanical working of metals

4.2.    Distinguish between Cold working and Hot working

4.3.    Explain working principle of hot rolling

4.4.    Explain working principle of Piercing

4.5.    Explain working principle of Spinning

4.6.    Explain working principle of hot rolling

4.7.    Explain working principle of Extrusion

4.8.    Explain working principle of Drawing

4.9.    Mention the advantages and disadvantages of Cold working

## COURSE CONTENT

### 1    Introduction

Methods of manufacturing processes - casting, forming, metal removal processes, joining processes, surface finishing processes, basic workshop processes - carpentry, fitting, hand forging, machine forging, sheet metal work, cold and hot working of metals.

### 1.1 Carpentry

1.1.1 **Marking & measuring tools**: scales, rules, fourfold wooden rule, flexible measuring rule (tape), straight edge, try square, bevel square, combination square, marking knife, marking gauge, mortise gauge, cutting gauge, wing compass, trammel, divider, outside calliper, inside calliper, odd leg calliper, spirit level, plum bob, specifications- uses.

1.1.2 **Cutting Tools**

**Saws:** ripsaw, cross cut saw (hand saw), panel saw, tenon or back saw, dovetail saw, bow saw, coping saw, compass saw, pad or keyhole saw, specifications & uses.

**Chisels:** Firmer chisel, bevelled edge firmer chisel, parting chisel, mortise chisel, inside and outside gauges, specifications and uses.

**Planes:** Jack plane (wooden jack plane, metal jack plane), rough plane, smoothing plane, rebate plane, plough plane, router, spoke shave, special planes and their specifications and uses.

**Boring Tools:**

Gimlet, braces- wheel brace, ratchet brace, bit-shell bit, twist bit (auger bit), expansive bit, centre bit, router bit, countersink bit, drill, reamer their specifications & uses.

1.1.2 **Striking tools:**

Hammers - Warrington hammer, claw hammer, mallet, Specifications & uses.

1.1.3 **Holding devices**

Bench vice, bench stop, bench hold fast, sash cramp (bar cramp) G- cramp, Hand screw, specifications & uses.

1.1.4 **Miscellaneous tools**

Rasps and files, scraper, oilstone, glass paper, pincer, screw driver, cabinet screw driver, ratchet-screw driver, saw set, oil stone slip- specifications and uses.

1.1.5 **Carpentry Processes**

Marking, measuring, sawing, chiselling, planning, boring, grooving, Rebating & moulding.

1.1.6 **Carpentry joints**

Halving Joint, mortise and tenon joint, bridle joint, butt joint. Dowel joint, tongue & groove joint, screw & slot joint, dovetail joint, corner joint.

1.1.7 **Wood working machines**

Wood working lathe (wood turning lathe), circular saw, band saw, wood planer, sanding machine, belt sander, spindle sander, disc sander and grinder, specifications and uses.

1.2 **Fitting**

1.2.1 **Cutting tools**

**Chisels:** Flat chisel, cross cut chisel, half round chisel, diamond point chisel, side chisel, specifications and uses.

**Files:** Different parts of a file – sizes and shapes - flat file, hand file, square file ,piller file ,round file, triangular file, half round files, knife edge file, needle file – specifications and uses.

**Scrapers:** Flat, triangular, half round scrapers, specifications & uses.

**Saws:** Hand hacksaw - solid frame, adjustable frame, specifications & uses, hand hacksaw blades. Power hack saw – description(horizontal reciprocating type), power hacksaw blade, specifications and uses, teeth set - saw material.

**Drill bits:** Flat drill, straight fluted drill, twist drill, parallel shank, tapered shank, specifications & uses.

**Reamer:** Hand reamer, machine reamer, straight and spiral flutes reamers, specifications and uses.

**Taps:** Hand taps - taper tap, plug tap and bottoming tap, specifications and uses.

**Dies & Sockets:** Dies- solid, adjustable - specifications and uses.

1.2.2 **Striking Tools**
**Hammers:** Parts, ball peen, cross peen, straight peen hammers, soft hammer, sizes, specifications and uses.

1.2.3 **Holding Devices**
**Vice**s: Bench vice, leg-vice, hand vice, pin vice, tool maker's vice, pipe vice, care of vices, specifications and uses.

1.2.4 **Marking Tools**
Surface plate, V-block, angle plate, try square, scriber, punch, prick punch, centre punch, number punch, letter punch, specifications and uses.

1.2.5 **Miscellaneous Tools**
Screw drivers, spanners, single ended & double ended, box type, adjustable spanners, cutting pliers, nose pliers, allen keys, specifications and uses.

1.2.6 **Checking and measuring instruments**
Checking instruments:
Callipers:Outside&Inside callipers, hermaphrodite (odd leg) calliper with firm joint, spring callipers, transfer calliper sizes & uses, dividers - sizes & uses**.**
Measuring instruments:
Combination square, bevel protractor, universal bevel protractor, sine bar, universal surface gauge, engineer's parallels, slip gauges, plane gauge, feeler gauge, angle gauge, radius & template gauge, screw pitch gauge, telescopic gauges, plate & wire gauge, ring and plug gauges, snap gauges specifications & uses, vernier callipers, vernier height gauge, vernier depth gauge, micrometer - outside & inside, stick micrometer, depth micrometer, vernier micrometer, screw thread micrometer specifications and uses.

1.2.7 **Fitting Operations**
Marking, sawing, chipping, filing, scrapping, grinding, drilling, reaming, tapping and dieing.

1.3 **Forging**

1.3.1 **Hand forging tools:** Anvil, swage block, hand hammers - types; sledge hammer, specifications and uses, tongs - types, specifications & uses, chisel - hot & cold chisels specifications & uses. Swages - types and sizes, fullers, flatters, set hammer, punch and drift - sizes and uses.

1.3.2 **Equipment:** Open and closed hearth heating furnaces, hand and power driven blowers, open and stock fire, fuels-charcoal, coal, oil gaseous fuels.

1.3.3 **Smith Operations:** Upsetting, drawing down, setting down, punching, drifting, bending, welding, cutting, swaging, fullering and flattering.

1.3.4 **Machine Forging:** Need of machine forging, forging hammers - spring hammer, pneumatic hammer, drop hammer, forging press, hydraulic press - line diagram,

machine forging operations - drawing, upsetting, punching, tools used in machine forging.

1.3.5 **Forging defects:** Types and remedies.

1.4 **Sheet Metal Work**

1.4.1 Metals used for sheet metal work.

1.4.2 **Sheet metal hand tools**:

**Measuring tools** - steel rule, circumference rule, thickness gauge, sheet metal gauge, straight edge, scriber, divider, trammel points, punches, chisels, hammers, snips or shears, straight snip, double cutting shear, squaring shear, circular shear, bench & block shears.

**Stakes:** Double seaming stake, beak horn stake, bevel edged square stake, Hatchet stake, needle stake, blow horn stake, hollow mandrel stake, pliers (flat nose and round nose), grocers and rivet sets, soldering iron, specifications & uses.

1.4.3 **Sheet Metal Operations**

**Shearing:** Cutting off, parting, blanking, punching, piercing, notching, slitting, lancing, nibbling and trimming.

**Bending:** Single bend, double bend, straight flange, edge hem, Embossing, beading, double hem or lock seam.

**Drawing:** Deep drawing, shallow or box drawing.

**Squeezing:** Sizing, coining, hobbling, ironing, riveting.

1.4.4 **Sheet Metal Joints**

**Hem Joint:** single hem, double hem & wired edge, seam joint -lap seam, grooved seam, single seam, double seam, dovetail seam, burred bottom seam or flanged seam.

1.4.5 **Fastening Methods**

Riveting, soldering, brazing & spot welding.

2 **Drilling**

2.1 **Type of drilling machines:** sensitive & radial drilling machines, their constructional details and specifications.

2.2 **Drill bits**: Terminology - geometry of twist drill - functions of drill elements.

2.3 **Operations:** Drilling, reaming, boring, counter boring, counter sinking, tapping, spot facing and trepanning.

3 **Foundry.**

3.1 **Introduction:** Development of foundry as a manufacturing process, advantages and limitations of casting over other manufacturing processes.

3.2 **Foundry equipment:**

**Hand moulding tools:** shovel, riddle, rammers, trowels, slicks, lifter, strike - off bar, sprue pin bellow, swab, gate cutter, mallet, vent rod, draw spike, rapping plate or lifting plate, pouring weight, gagger, clamps, spirit level, moulding boxes, snap box & flash box.

3.3 **Sands:** Properties of moulding sand - porosity, flow ability, collapsibility, adhesiveness, cohesiveness and refractoriness.

3.4 **Types of moulding sand** : green sand, dry sand, loam sand, facing sand, backing sand, parting sand, core sand, systems and their ingredients and uses.

3.5 **Pattern making:** Materials such as wood, cast Iron, aluminium, brass, plastics their uses and relative advantages, classification of patterns such as solid (one piece), two piece and three pieces, split patterns, gate patterns and shell patterns, sequence in pattern making, pattern allowances and colour codes.

3.6 **Cores:** Need of cores, types of cores.

3.7 Casting: green sand and dry sand moulding, cement bonded moulding, shell moulding, ceramic moulding, defects in castings and their remedies.

3.8 Special casting processes: (Principles and applications only) die casting – hot chamber and cold chamber, centrifugal casting, $CO_2$ process, investment casting

4 **Mechanical working of metals**

4.1 **Introduction:** Hot working and cold working

4.2 **Hot working processes:** rolling - types of rolling, two high mill, three high mills, four high mills, piercing or seamless tubing, drawing or cupping, spinning, extrusion - direct or forward extrusion, indirect or backward extrusion, tube extrusion, Impact extrusion.

4.3 Effects of hot working of metals**,** advantages & limitations of hot working of metals.

4.4 **Cold working process:**
Rolling, drawing - wire drawing, tube drawing, bending, roll forming, angle bending, spinning, extrusion, squeezing, cold heading, thread rolling, peening.

4.5 Effects of cold working of metals, advantages & limitations of cold working.

**REFERENCE BOOKS**

1. Production Technology by Jain & Gupta (Khanna Publishers)
2. Elementary Workshop Technology by Hazra Chowdary & Bhattacharya
(Media Promoters)
3. Manufacturing Technology (Vol ) by P N Rao (McGraw Hill)
4. Workshop Technology Vol I & II by Raghuvamshi

# ENGINEERING DRAWING

| Course Code | Course Title | No. of Periods per Week | Total No. of Periods | Marks for Formative Assessment | Marks for Summative Assessment |
|---|---|---|---|---|---|
| M-107 | ENGINEERING DRAWING | 06 | 180 | 40 | 60 |

## TIME SCHEDULE

| S.No | Chapter/Unit Title | No. of Drawing plates | Periods | Weightage of Marks | Short Answer Questions (5 M) | Essay Type Questions ( 10 M) |
|---|---|---|---|---|---|---|
| 1 | Importance of Engineering Drawing | -- | 01 | - | - | - |
| 2 | Engineering Drawing Instruments | 01 | 05 | - | - | - |
| 3 | Free hand lettering & Numbering | 01 | 06 | 05 | 1 | - |
| 4 | Dimensioning Practice | 01 | 09 | 05 | 1 | - |
| 5 | Geometrical constructions | 03 | 24 | 15 | 1 | 1 |
| 6 | Projections of Points, Lines, Planes & Auxiliary Planes | 03 | 21 | 05 | 1 | |
| 7 | Projections of Solids | 01 | 12 | 10 | | 1 |
| 8 | Sections of Solids | 01 | 21 | 10 | - | 1 |
| 9 | Orthographic Projections | 01 | 30 | 10 | - | 1 |
| 10 | Isometric Views | 01 | 30 | 10 | - | 1 |
| 11 | Development of surfaces | 01 | 21 | 10 | - | 1 |
| | **Total** | **14** | **180** | **80** | **04** | **06** |

**Course Objectives and Course Outcomes**

| Course Objectives | | Upon completion of the course the student shall able to understand<br>the basic graphic skills and use them in preparation of engineering drawings, their reading and interpretation | |
|---|---|---|---|
| **Course Outcomes** | **CO1** | M-107.1 | Describe the use of engineering drawing instruments |
| | **CO2** | M-107.2 | Practice the conventions to be followed in engineering drawing as per BIS |
| | **CO3** | M-107.3 | Draw i) basic geometrical constructions ii) engineering curves |
| | **CO4** | M-107.4 | Draw the orthographic projections of i) Points  ii) Lines iii) Regular Planes   iv) Regular Solids   V) Sections of Regular Solids |
| | **CO5** | M-107.5 | Practice isometric views of machine components |
| | **CO6** | M-107.6 | Draw the developments of surfaces of regular solids and use them to make the components used in daily life |

**LEARNING OUTCOMES**
Upon completion of the course the student shall able to

**1.0    Understand the basic concepts of Engineering Drawing**
    1.1 State the importance of drawing as an engineering communication medium
    1.2 State the necessity of B.I.S. Code of practice for Engineering Drawing.
    1.3 Explain the linkages between Engineering drawing and other subjects of Mechanical Engineering

**2.0    Use of Engineering Drawing Instruments**
    2.1 Select the correct instruments to draw the different lines / curves
    2.2 Use correct grade of pencil to draw different types of lines and for different purposes
    2.3 Select and use appropriate scales for a given application.
    2.4 Identify different drawing sheet sizes as per I.S. and Standard Lay- outs.
    2.5 Prepare Title block as per B.I.S. Specifications.
    2.6 Identify the steps to be taken to keep the drawing clean and tidy.
        Drawing Plate 1: Use of Engineering Drawing Instruments
**3.0    Write Free Hand Lettering and Numbering**
    3.1 Write titles using vertical lettering and numerals of 7mm, 10mm and 14mm height
    3.2 Write titles using sloping lettering and numerals of 7mm, 10mm and 14mm height
    3.3  Select suitable sizes of lettering for different layouts and applications
    Drawing plate 2: Exercises on Free hand lettering and numbering

**4.0    Understand Dimensioning Practice**
    4.2    Acquaint with the conventions, notations, rules and methods of
            dimensioning in engineering drawing as per the B.I.S.
    4.5    Dimension a given drawing using standard notations and desired
            system of dimensioning.
Drawing Plate 3: Exercises on Dimensioning Practice

**5.0    Apply Principles of Geometric Constructions**
    5.1    Practice the basic geometric constructions like i) dividing a line into
    equal parts
            ii) Exterior and interior tangents to the given two circles   iii) tangent
            arcs to two given lines and arcs
    5.2    Draw any regular polygon using general method when i) side length is
    given ii) inscribing circle radius is given   iii) describing circle radius is given
    5.2    Draw the conics using general and special methods,
    5.3    Draw the engineering curves like i) involute ii) cycloid   iii) helix
Drawing Plate -4: Having problems up to construction of polygon
Drawing Plate -5: Having problems of construction of conics
Drawing Plate -6: Having problems of construction of involute, cycloid and helix
**6.0    Projections of points, lines, planes & auxiliary planes**
    6.1    Explain the basic principles of the orthographic projections
    6.2    Visualise and draw the projection of a point with respect to reference
            planes (HP&VP)
    6.3    Visualise and draw the projections of straight lines with respect to two
    references Planes (up to lines parallel to one plane and inclined to other
    plane)
    6.4    Visualise and draw the projections of planes (up to planes
            perpendicular to one plane and inclined to other plane)
    6.5    Draw the auxiliary views of a given engineering component
Drawing Plate -7: problems on projection of points and Lines
Drawing Plate -8: problems on projection of planes
Drawing Plate -9: problems on auxiliary planes
**7.0    Draw the Projections of Solids**
    7.1 Visualise and draw the projections of regular solids like Prisms, Pyramids,
        Cylinder, and Cone (up to axis of solids parallel to one plane and inclined
        to other plane)
Drawing plate No.10: Problems on projection of solids
**8.0    Appreciate the need of Sectional Views**
    8.1    Identify the need to draw sectional views.
    8.4    Differentiate between true shape and apparent shape of section
    8.5    Draw sectional views and true sections of regular solids by applying the
    principles of hatching.
Drawing Plate–11: Problems on section of solids
**9.0    Apply principles of orthographic projection**
    9.1   Draw the orthographic views of an object from its pictorial drawing.
    9.2   Draw the minimum number of views needed to represent a given object
    fully.
Drawing Plate 12: Problems on **orthographic projections**
**10.0   Prepare pictorial drawings**
    10.1    identify the need of pictorial drawings.

10.2 Differentiate between isometric scale and true scale.

10.3 Prepare Isometric views from the given orthographic drawings.

Drawing plate 13: Exercise on Isometric drawings only.

## 11.0 Interpret Development of surfaces of different solids.

11.1 State the need for preparing development drawing.

11.2 Draw the development of simple engineering objects and their truncations (cubes, prisms, cylinders, cones, and pyramid)

11.3 Prepare development of surface of engineering components like i) funnel  ii) $90^0$ elbow iii) Tray

Drawing plate No. 14:  Problems on Development of surfaces

**Competencies and Key competencies to be achieved by the student**

| S.No | Major topic | Key Competency |
|------|-------------|----------------|
| 1. | Importance of Engineering Drawing | • Explain the linkages between Engineering drawing and other subjects of study in Diploma course. |
| 2. | Engineering Drawing Instruments | • Select the correct instruments to draw various entities in different orientation |
| 3. | Free hand lettering & Numbering | • Write titles using sloping and vertical lettering and numerals as per B.I.S (Bureau of Indian standards) |
| 4. | Dimensioning Practice | • Dimension a given drawing using standard notations and desired system of dimensioning |
| 5. | Geometrical construction | • Construct ellipse, parabola, rectangular hyperbola, involute, cycloid and helix from the given data. |
| 6. | Projection of points, Lines, Planes & Solids | • Draw the projections of points, straight lines, planes & solids with respect to reference planes (HP & VP) |
| 7. | Auxiliary views | • Draw the auxiliary views of a given Engineering component<br>• Differentiate between Auxiliary view and apparent view |
| 8. | Sections of Solids | • Differentiate between true shape and apparent shape of section<br>• Apply principles of hatching.<br>• Draw simple sections of regular solids |
| 9. | Orthographic Projection | • Draw the minimum number of views needed to represent a given object fully. |
| 10. | Isometric Views | • Differentiate between isometric scale and true scale.<br>• Draw the isometric views of given objects,. |
| 11. | Development of surfaces | • Prepare development of Surface of regular solids and other components like i) funnel<br>ii) $90^0$ elbow  iii) Tray |

## COURSE CONTENTS:

**NOTES:**

1. **B.I.S Specification should invariably be followed in all the topics.**
2. **A-3 Size Drawing Sheets are to be used for all Drawing Practice Exercises.**

## 1.0    The importance of Engineering Drawing

Explanation of the scope and objectives of the subject of Engineering Drawing Its importance as a graphic communication -Need for preparing drawing as per standards – SP-46 –1988 – Mention B.I.S - Role of drawing in - engineering education – Link between Engineering drawing and other subjects of study.

**2.0    Engineering drawing Instruments**

Classifications: Basic Tools, tools for drawing straight lines, tools for curved lines, tools for measuring distances and special tools like mini drafter & drafting machine – Mentioning of names under each classification and their brief description -Scales: Recommended scales reduced & enlarged -Lines: Types of lines, selection of line thickness - Selection of Pencils -Sheet Sizes: A0, A1, A2, A3, A4, A5, Layout of drawing sheets in respect of A0, A1, A3 sizes, Sizes of the Title block and its contents - Care and maintenance of Drawing Sheet,

**3.0    Free hand lettering & numbering**

Importance of lettering – Types of lettering -Guide Lines for Lettering
Practicing of letters & numbers of given sizes (7mm, 10mm and 14mm)
Advantages of single stroke or simple style of lettering - Use of lettering stencils

**4.0    Dimensioning practice**

Purpose of engineering Drawing, Need of B.I.S code in dimensioning -Shape description of an Engineering object -Definition of Dimensioning size description -Location of features, surface finish, fully dimensioned Drawing - Notations or tools of dimensioning, dimension line extension line, leader line, arrows, symbols, number and notes, rules to be observed in the use of above tools -Placing dimensions: Aligned system and unidirectional system ( SP-46-1988)-Arrangement of dimensions Chain, parallel, combined progressive, and dimensioning by co-ordinate methods-The rules for dimensioning standard, features "Circles (holes) arcs, angles, tapers, chamfers, and dimension of narrow spaces.

**5.0    Geometric Construction**

**Division of a line**: to divide a straight line into given number of equal parts
**Construction of tangent lines**: to draw interior and exterior tangents to two circles of given radii and centre distance
**Construction of tangent arcs:**
i) To draw tangent arc of given radius to touch two lines inclined at given angle (acute, right and obtuse angles).
ii)Tangent arc of given radius touching a circle or an arc and a given line.
iii)Tangent arcs of radius R, touching two given circles internally and externally.
**Construction of polygon**: construction of any regular polygon by general method for given side length, inscribing circle radius and describing/superscribing circle radius
**Conics:** Explanation of Ellipse, Parabola, Hyperbola, as sections of a double cone and a loci of a moving point, Eccentricity of above curves – Their Engg. Applications viz., Projectiles, reflectors, Cooling Towers, P-V Diagram of a Hyperbolic process - Construction of any conic section of given eccentricity by general method - Construction of ellipse by concentric circles method, Oblong Method and Arcs of circles method - Construction of parabola by rectangle method and Tangent method - Construction of rectangular hyperbola

**General Curves:** Involute, Cycloid and Helix, explanations as locus of a moving point, their engineering application, viz., Gear tooth profile, screw threads, springs etc. – their construction

**6.0    Projection of points, lines and planes & auxiliary views**

Classification of projections, Observer, Object, Projectors, Projection, Reference Planes, Reference Line, Various angles of projections –Differences between first angle and third angle projections

**Projections of points in different quadrants**

**Projections of straight line -**

(a) Parallel to both the planes.

(b) Perpendicular to one of the planes.

(c) Inclined to one plane and parallel to other planes

**Projections of regular planes**

(a) Plane parallel to one of the reference planes

(b) Plane perpendicular to HP and inclined to VP and vice versa.

**Auxiliary views**

Need for drawing auxiliary views -Explanation of the basic principles of drawing an auxiliary views explanation of reference plane and auxiliary plane - Partial auxiliary view.

**7.0     Projections of regular solids**

(a) Axis perpendicular to one of the  planes

(b) Axis parallel to VP and inclined to HP and vice versa.

**8.0     Sections of Solids**

Need for drawing sectional views – what is a sectional view - Hatching – Section of regular solids inclined to one plane and parallel to other plane

**9.0    Orthographic Projections**

Meaning of orthographic projection - Using a viewing box and a model – Number of views obtained on the six faces of the box, - Legible sketches of only 3 views for describing object -Concept of front view, top view, and side view sketching these views for a number of engg objects - Explanation of first angle projection. – Positioning of three views in First angle projection - Projection of points as a means of locating the corners of the surfaces of an object – Use of miter line in drawing a third view when other two views are given -Method of representing hidden lines -Selection of minimum number of views to describe an object fully.

**10.0  Pictorial Drawings**

Brief description of different types of pictorial drawing viz., Isometric, oblique, and perspective and their use - Isometric drawings: Isometric axes, angle between them, meaning of  visual distortion in dimensions - Need for an isometric scale, difference between Isometric scale, and   true scale - difference between Isometric  view and  Isometric projection - Isometric and non-Isometric lines -Isometric drawing of common features like rectangles, circular - shapes, non-isometric lines – Drawing the isometric views for the given orthographic projections -Use of box / offset method

## 11.0  Development of Surfaces

Need for preparing development of surface with reference to sheet metal work-Concept of true length of a line with reference to its orthographic projection when the line is (i) parallel to the plane of projection (ii) inclined to one principal and parallel to the other -Development of simple solids like cubes, prisms, cylinders, cones, pyramid and truncation of these solids-Types of development: Parallel line and radial line development -Procedure of drawing development of  funnels, $90^0$ elbow pipes, Tray.

**REFERENCE BOOKS**

Engineering Graphics by P I Varghese – ( McGraw-hill)
Engineering Drawing by Basant  Agarwal & C.M Agarwal - ( McGraw-hill)
Engineering Drawing by N.D.Bhatt.
T.S.M. & S.S.M on " Technical Drawing" prepared by T.T.T.I., Madras.
SP-46-1998 – Bureau of Indian Standards.

# BASIC WORKSHOP PRACTICE

| Subject Title | Subject Code | Periods/Week | Periods Per Year |
|---|---|---|---|
| Basic Workshop Practice | M -108 | 06 | 180 |

## TIMESCHEDULE

| S.No | Major Title | No of Periods |
|---|---|---|
| 1. | Fitting shop | 36 |
| 2. | Forging shop | 39 |
| 3. | Carpentry shop | 51 |
| 4. | Sheet metal work | 48 |
| 5 | Plumbing | 06 |
| | **Total** | **180** |

## Course Objectives and Course Outcomes

<table>
<tr>
<td rowspan="2"><b>Course Objectives</b></td>
<td colspan="3"><b>Upon completion of the course the student shall able to</b><br>(i)    Familiarize tools used in Basic workshop processes<br>(ii)   Handle the tools appropriately and safely<br>(iii)  Reinforce theoretical concepts by practising relevant exercises of basic workshop processes</td>
</tr>
</table>

| Course Outcomes | CO1 | M-108.1 | Practice the operations in Fitting Shop |
|---|---|---|---|
| | CO2 | M-108.2 | Practice the operations in Forging Shop |
| | CO3 | M-108.3 | Practice the operations in Carpentry Shop |
| | CO4 | M-108.4 | Practice the operations in Sheet metal Shop |
| | CO5 | M-108.5 | Practice the operations in Plumbing |

**Learning Outcomes:**
Upon completion of the course the student shall able to

1. Perform Marking and Chipping operations on Mild steel flat of 12 mm thick
   1.1 Identify appropriate measuring tool
   1.2 Handle appropriate marking tool
   1.3 Handle appropriate chipping tool
   1.4 Mark the dimensions

2. Cutting with hack saw of MS flats of 6mm thick
   2.1 Check the raw material for size
   2.2 Fix the work piece in vice
   2.3 Mark the work as per given dimensions
   2.4 Perform dot punching
   2.5 Load and unload hack saw blade from its frame

3. Drilling, chamfering on a MS flat of 2 mm thick
   3.1 Check the raw material for size
   3.2 Apply the chalk on the surface and on all sides of the flat

3.3 Layout the dimensions and mark the lines using dot punch

3.4 Chamfer the edges through filing

3.5 Locate the whole centres using odd leg callipers and centre punching

3.6 Identify appropriate drill bi

3.7 Load and unload drill bit from the machine

4. Tapping and Dieing on a MS flat of 2 mm thick

4.1  Check the raw material for size

4.2 Identify appropriate tap and die

4.3 Secure the tap in the wrench

4.4 Perform Tapping

4.5 Hold the bar in bench vice

4.6 Fix the die in die stock

4.7 Cut external threads using a Die

4.8 Check the fit for accuracy

5. .Assembling of two pieces, matching by filing

5.1  Cut the pieces to size using hack saw

5.2 File surface of flat for trueness

5.3 Mark the surfaces as per dimensions

5.4 Perform cutting with hack saw as per marked lines

5.5 Smooth the surfaces with file

5.6 Assemble the two pieces

6. Conversion of Round to Square

6.1 Identify the holding and striking tools

6.2 Heat the specimen to the appropriate temperature

6.3 Remove the specimen and hold it on the anvil

6.4 Hammer the specimen to the required shape

7 Conversion of Round to Hexagon

7.1 Identify the holding and striking tools

7.2 Heat the specimen to the appropriate temperature

7.3 Remove the specimen and hold it on the anvil

7.4 Hammer the specimen to the required shape

8. Preparation of a Chisel from round rod

8.1  Identify the holding and striking tools

8.2  Heat the specimen to the appropriate temperature

8.3  Remove the specimen and hold it on the anvil

8.4 Hammer the specimen to the required shape

9. Preparation of a ring and hook from M.S round

9.1  Identify the holding and striking tools

9.2  Heat the specimen to the appropriate temperature

9.3 Remove the specimen and hold it on the anvil

9.4  Hammer the specimen to the required shape

10. Preparation of a hexagonal bolt and nut

10.1 Identify the holding and striking tools

10.2 Heat the specimen to the appropriate temperature

 10.3 Remove the specimen and hold it on the anvil

10.4 Hammer the specimen to the required shape

11. Cutting of wood with hand saw

11.1 Identify the orientation of grains

11.2 Select appropriate saw for cutting in each of the directions viz. across and along the grains

11.3 Select appropriate work holding device

11.4 Handle appropriate measuring and marking tools (Steel rule, Try square, Marking gauge)

11.5 Mark dimensions on work using Marking gauge

11.6 Fix the work in the vice

11.7 Perform cutting along the grains using Rip saw

11.8 Perform cutting perpendicular to the grains using cross cut saw

12. Planning of wood

12.1 Identify the direction for planning wood stock

12.2 Select appropriate jack plane

12.3 Prepare the jack plane for planning

12.4 Load and unload the blade of a jack plane

12.5 Select appropriate work holding device

12.6 Perform marking on work using appropriate tool

12.7 Fix the work in the vice

12.8 Plane the surfaces on all four sides using jack plane

13. .Chiselling of wood

13.1 Select appropriate chisels and saw

13.2 Select appropriate work holding device

13.3 Select appropriate measuring and marking tools

13.4 Fix the work in the vice

13.5 Mark the position of grooves on work using marking gauge

13.6 Cut sides of grooves by hand saw

13.7 Chip the material using firmer chisel by applying pressure with mallet

13.8 Finish the grooves with rasp file

14. Preparation of a Dove-tail joint

14.1 Select the appropriate cutting tools and work holding devices

14.2 Plane the wooden pieces on all sides

14.3 Mark at an angle of 150 with bevel square

14.4 Trim the dovetail by chisel to exact size

14.5 Cut the dovetail groove on second piece

14.6 Finish the groove

14.7 Assemble the two pieces to prepare dovetail halving joint by using mallet

15. Preparation of Mortise and Tenon joint

15.1 Select the appropriate cutting tools and work holding devices

15.2 Plane the two pieces to the required size using jack plane

15.3 Mark the dimensions to make Tenon using mortise gauge

15.4 Cut tenon with tenon saw along the marked lines

15.5 Use firmer chisel to remove the excess material to set finished tenon

15.6 Mark the dimension to make mortise on the second piece with mortise gauge

15.7 Use mortise chisel to provide recess in the second piece to accommodate tenon

15.8 Assemble the two pieces by fitting the tenon into mortise

16. Wood turning on lathe

16.1 Select appropriate tools

16.2 Plane the four corners of the work piece using jack plane

16.3 Mark the centres of the work on either side

16.4 Mount the work between head stock & tailstock centres

16.5 Fix the tool in the tool post & Position it in appropriate height

16.6 Start the lathe to make the work piece to revolve at desired speed

16.7 Feed the bevel gauge against the rotating work to get the required size and shape

16.8 Use outside callipers to check the diameter of the pin

16.9 Use parting off tool to reduce the diameter on either ends of the    pin

16.10 Remove the rolling pin between centres and cut off excess material on either sides

17. Preparation of any household article (ex: stool)

17.1 Prepare the drawings of a stool required for a particular drawing table

17.2 State the specifications of the wood stock required

17.3 Identify the type of joints to be made

17.4 Identify the operations to be made and their sequence

17.5 Perform operations to produce pieces of joint

17.6 Assemble all joints as per the drawing

18. Practice on cutting of sheet

18.1 Cut the required sheet from the stock using snip

18.2 Mark the dimensions on the sheet using scriber & steel rule

18.3 Draw the circular shapes using divider

18.4 Perform rough cutting of the curved shapes using chisel and finish cutting using snips

18.5 Cut the straight edges using straight snip

19. Formation of joints like grooved joint, locked groove joint

19.1 Cut the sheet into two halves

19.2 Form the flange on the sheet by folding the sheet along scribed lines using mallet & stakes

19.3 Perform bending edges of sheets applying moderate pressure using mallet

19.4 Interlock the bent edges and apply pressure with mallet to make required joint

20. Preparation of a rectangular open type tray

20.1 Draw the development of the object to be made

20.2 Place the pattern on the sheet

20.3 Mark the dimensions using scriber
20.4 Shear the required piece from the stock using straight snips
20.5 Mark the lines on the sheet to form bends
20.6 Strengthen the sides of sheet by single hem using hatchet stake
20.7 Form the sheet into desired shape using stakes
20.8 Seam the corners by inserting laps of the adjacent sides with single hem

21. Preparation of hollow cylinder
21.1 Draw the development of the object to be made
21.2 Place the pattern on the sheet
21.3 Mark the dimensions using scriber
21.4 Shear the required piece from the stock using straight snips
21.5 Mark the lines on the sheet to form bends
21.6 Strengthen the sides of sheet by single hem on top & bottom side using hatchet stake
21.7 Form the flat sheet into cylindrical shape by cylindrical stake and apply pressure using mallet
21.8 Prepare single hem on to longitudinal sides in opposite directions
21.9 Interlock the sides and apply pressure to make a strong joint

22. .Preparation of pipe elbow
22.1 Draw the development of a cylindrical pipe truncated at an angle   of 450 on one side
22.2 Cut the sheet over the marked dimensions using curved snips
22.3 Form the sheet into cylindrical shape using stakes
22.4 Seam the sides of two pipes using mallet
22.5 Seam the two pipes
22.6 Solder the joint to make leak proof

23. Preparation of funnel
23.1 Draw the development of upper and bottom conical parts
23.2 Place the pattern on the sheet and cut to required size
23.3 Form the sheet into conical shape using appropriate stake and mallet
23.4 Seam the top conical part and bottom conical part to obtain required funnel

24. Preparation of utility articles such as dust pan, kerosene hand pump
24.1 Draw the development of given dust pan
24.2 Scribe the lines on the sheet and cut to required size
24.3 Hem all the four sides to strengthen the edges
24.3 Form the sheet into designed shape using suitable stakes and mallet
24.4 Solder the corner lap joints to make the required dust pan

24. Preparation of pipe joint with pipe fittings
24.1 Select the plumbing tools:  pipe wrench, pipe vice, Hack Saw, Pipe Cutter, pipe Threading Dies
24.2 select pipe fittings: Coupling, union, nipple, Elbow, Tee, Reducer
24.3 Perform pipe fitting operations on the pipe

24. Thread cutting on Pipe

     25.1 Select the plumbing tools: pipe wrench, pipe vice, Hack Saw, Pipe Cutter, pipe Threading Dies

     25.2 Perform thread cutting on pipe

## COURSE CONTENT
## FITTING SHOP
1. Marking and chipping on Mild – steel flat 12 mm thick.
2. Cutting with hack saw, M.S. Flats of 6 mm thick.
3. Marking, cutting, drilling, Chamfering and tapping on a M.S. Flat 12 mm thick.
4. Assembling of two pieces, Matching by filing (6 mm thick M.S. Plate)

## FORGING SHOP
1. Conversion of round to square.
2. Conversion of round to Hexagon.
3. Preparation of chisel from round rod.
4. Preparation of ring and hook from M.S. round.
5. Preparation of a hexagonal bolt and nut.

## CARPENTRY SHOP
1. Cutting of wood with hand saw.
2. Planning of wood.
3. Planning and chiselling of wood.
4. Preparation of dovetail joint.
5. Mortise and tenon joint.
6. Wood turning on a lathe.
7. Preparation of one household article.

## SHEET METAL WORK
1. Practice on cutting of sheet
2. Formation of joints like grooved joints, locked groove joint
3. Preparation of a rectangular open type tray
4. Preparation of hollow cylinder
5. Preparation of pipe elbow
6. Preparation of mug.
7. Preparation of funnel
8. Preparation of utility articles such as dustpan, kerosene hand pump.

## Plumbing Practice
1    Familiarization of Plumbing Tools
2  Familiarization of Pipefitting
    3.   Familiarization of Plumbing Operations


## REFERENCE BOOKS
1. Manufacturing Technology (Vol I )     by  P N Rao (McGraw Hill)
2. Principles of Foundry Technology     by   P L Jain (McGraw Hill)
3. Workshop Practice Vol- I by HajraChoudhury Media Promoters and Publishers Pvt Ltd.

## EE -PHYSICS LAB PRACTICE
## (C-20 CURRIUCULUM COMMON TO ALL BRANCHES)

| Subject Code | Subject Title | Periods per week | Total periods per year |
|---|---|---|---|
| M-109 | Physics Laboratory | 03 | 45 |

## TIMESCHEDULE

| S.No | Name of the Experiment | No.of Periods |
|---|---|---|
| 1. | Hands on practice on Vernier Calipers | 03 |
| 2. | Hands on practice on Screw gauge | 03 |
| 3. | Verification of Parallelogram law of forces and Triangle law of | 03 |
| 4. | Simple pendulum | 03 |
| 5. | Velocity of sound in air – (Resonance method) | 03 |
| 6. | Focal length and Focal power of convex lens (Separate & | 03 |
| 7. | Refractive index of solid using traveling microscope | 03 |
| 8. | Boyle's law verification | 03 |
| 9. | Meter bridge | 03 |
| 10. | Mapping of magnet lines of force and locate null points | 03 |
| | **DEMONSTRATION EXPERIMENTS** | |
| 11. | Surface tension of liquid using traveling microscope | 03 |
| 12. | Coefficient of viscosity by capillary method | 03 |
| | Revision | 06 |
| | Test | 03 |
| | **Total** | **45** |

**Objectives:**
　　　**Upon completion of the course the student shall be able to**
1.0 Practice with Vernier calipers to determine the volumes and areas of a cylinder and sphere and their comparison etc .
2.0　Practice with Screw gauge to determine thickness of a glass plate, cross sectional area of a wire and volumes of sphere and also their comparison etc
3.0　Verify the parallelogram law and Triangle law
4.0　Determine the value of acceleration due to gravity using Simple Pendulum
5.0　Determine the velocity of sound in air at room temperature and its value at zero degree centigrade.
6.0　Calculate the Focal length and focal power of convex lenses using distant object method , U-V method , U-V graph and 1 / U – 1 / V  graph methods and their comparison.
7.0　Determine the refractive index of a solid using travelling microscope.
8.0　Verify the Boyle's law employing a Quill tube.
9.0　Determine the specific resistance of material of a wirel using Meter Bridge.

10.0    Drawing magnetic lines of force under N-S and N-N methods and locate null points.

11.0    Determine the surface tension of a liquid using travelling Microscope (**Demo)**

12.0    Determine the viscosity of a liquid using capillary method (**Demo)**

**Competencies and Key competencies to be achieved by the student**

| Name of the Experiment | Competencies | Key competencies |
|---|---|---|
| 1. Hands on practice on Vernier Calipers (03) | • Find the Least count<br>• Fix the specimen in posit<br>• Read the scales<br>• Calculate the physical quantities of given object | • Read the scales<br>• Calculate the requisite physical quantities of given objects |
| 2. Hands on practice on Screw gauge(03) | • Find the Least count<br>• Fix the specimen in posit<br>• Read the scales<br>• Calculate thickness of glass place and cross section of wire and other quantities | • Read the scales<br>• Calculate thickness of given glass plate<br>• Calculate cross section of wire and other quantities |
| 3. Verification of Parallelogram law of forces and Triangle law of forces(03) | • Fix suitable weights<br>• Note the positions of threads on drawing sheet<br>• Find the angle at equilibrium point<br>• Construct parallelogram<br>• Compare the measured diagonal<br>• Construct triangle<br>• Find the length of sides<br>• Compare the ratios | • Find the angle at equilibrium point<br>• Constructing parallelogram<br>• Construct triangle<br>• Compare the ratios of force and length |
| 4. Simple pendulum(03) | • Fix the simple pendulum to the stand<br>• Adjust the length of pendulum<br>• Find the time for number of oscillations<br>• Find the time period<br>• Calculate the acceleration due to gravity<br>• Draw l-T and l-$T^2$ graph | • Find the time for number of oscillations<br>• Find the time period<br>• Calculate the acceleration due to gravity<br>• Draw l-T and l-$T^2$ graph |
| 5. Velocity of sound in air –Resonance method (03) | • Arrange the resonance apparatus<br>• Adjust the reservoir level for booming sound<br>• Find the first and second resonanting lengths<br>• Calculate velocity of sound | • Adjust the reservoir level<br>• Find the first and second resonating lengths<br>• Calculate velocity of sound at room temperature<br>• Calculate velocity of sound at $0^0$ C |

| | | |
|---|---|---|
| 6. Focal length and Focal power of convex lens (Separate & Combination) (03) | • Fix the object distance<br>• Find the Image distance<br>• Calculate the focal length and power of convex lens and combination of convex lenses<br>• Draw u-v and 1/u – 1/v graphs | • Calculate the focal length and power of convex lens<br>• Draw u-v and 1/u – 1/v graphs |
| 7. Refractive index of solid using traveling microscope(03) | • Find the least count of vernier on microscope<br>• Place the graph paper below microscope<br>• Read the scale<br>• Calculate the refractive index of glass slab | • Read the scale<br>• Calculate the refractive index of glass slab |
| 8. Boyle's law verification (03) | • Note the atmospheric pressure<br>• Fix the quill tube to retort stand<br>• Find the length of air column<br>• Find the pressure of enclosed air<br>• Find and compare the calculated value P x l | • Find the length of air column<br>• Find the pressure of enclosed air<br>• Find the value P x l |
| 9. Meter bridge(03) | • Make the circuit connections<br>• Find the balancing length<br>• Calculate unknown resistance<br>• Find the radius of wire<br>• Calculate the specific resistance | • Find the balancing length<br>• Calculate unknown resistance<br>• Calculate the specific resistance |
| 10. Mapping of magnet lines of force(03) | • Draw magnetic meridian<br>• Placed the bar magnet in NN and NS directions<br>• Draw magnetic lines of force<br>• Locate the neutral points along equatorial and axial lines | • Draw magnetic lines of force<br>• Locate the neutral points along equatorial and axial lines |

| 11. Surface tension of liquid using traveling microscope(03) | • Find the least count of vernier on microscope<br>• Focus the microscope to the lower meniscus & bent pin<br>• Read the scale<br>• Calculate height of liquid rise<br>• Calculate the surface tension of water | • Read the scale<br>• Calculate height of liquid rise<br>• Calculate the surface tension of water |
|---|---|---|
| 12.. Coefficient of viscosity by capillary method(03) | • Find the least count of vernier<br>• Fix the capillary tube to aspiratory bottle<br>• Find the mass of collected water<br>• Find the pressure head<br>• Calculate rate of volume of liquid collected<br>• Find the radius of capillary tube<br>• Calculate the viscosity of water using capillary method | • Find the pressure head<br>• Calculate rate of volume of liquid collected<br>• Find the radius of capillary tube<br>• Calculate the viscosity of water |

**Scheme of Valuation for end Lab Practical Examination :**

A. Writing Aim, Apparatus, Formula, Graph, Precautions carries        10 (Ten) Marks
B. For Drawing the table, taking Readings, Calculation work, Drawing the graph, finding result carries        15 (Fifteen) Marks
C. Viva Voice        05 (Five) Marks

      **Total        30 (Thirty) Marks**

➢ **Course outcomes**

| | | |
|---|---|---|
| | CO1 | Experiments with Vernier calipers, Screw gauge, Parallelogram law and Triangle law |
| | CO2 | Experiments with Simple pendulum, Resonance apparatus (Velocity of sound in air ) |
| **Course Outcomes** | CO3 | Experiments with Convex lens, Refractive index of solid by travelling microscope |
| | CO4 | Experiments with quill tube (Boyles law verification), Meter bridge, Mapping of magnetic lines of force |
| | CO5 | Experiments with Surface tension and Viscosity |

## CHEMISTRY LAB PRACTICE
### (C-20 curriculum common to all Branches)

| Subject Code | Subject Title | Periods per week | Total periods per year |
|---|---|---|---|
| C -110 | Chemistry Lab PRACTICE | 03 | 45 |

| CO1 | Operate and practice volumetric apparatus and preparation of standard solution |
|---|---|
| CO2 | Evaluate and judge the neutralization point in acid base titration |
| CO3 | Evaluate the end point of reduction and oxidation reaction |
| CO4 | Judge the stable end point of complex formation, stable precipitation |
| CO5 | Judge operate and demonstrate and perform precise operations with instrument for investigation of water pollution parameters |

### TIMESCHEDULE

| S. No | Name of the Experiment | No.of Periods | Mapped with COs |
|---|---|---|---|
| 1. | a) Recognition of chemical substances and solutions used in the laboratory by senses. b) Familiarization of methods for Volumetric analysis | 03 | CO 1 |
| 2. | Preparation of Std $Na_2CO_3$ and making solutions of | 03 | CO1 |
| 3. | Estimation of HCl solution using Std.$Na_2CO_3$ solution | 03 | CO2 |
| 4. | Estimation of NaOH using Std.HCl solution | 03 | CO2 |
| 5. | Estimation of $H_2SO_4$ usingStd.NaOH solution | 03 | CO2 |
| 6. | Estimation of Mohr's Salt using Std.$KMnO_4$ | 03 | CO3 |
| 7. | Determination of acidity of water sample | 03 | CO2 |
| 8. | Determination of alkalinity of water sample | 03 | CO2 |
| 9. | Determination of total hardness of water using Std. EDTA | 03 | CO4 |
| 10. | Estimation of Chlorides present in water sample | 03 | CO4 |
| 11. | Estimation of Dissolved Oxygen(D.O )in water sample | 03 | CO5 |
| 12. | Determination of pH using pH meter | 03 | CO5 |
| 13. | Determination of conductivity of water and adjusting ionic | 03 | CO5 |
| 14. | Determination of turbidity of water | 03 | CO5 |
| 15. | Estimation of total solids present in water sample | 03 | CO5 |
| | **Total:** | **45** | |

**Objectives:**

**Upon completion of the course the student shall be able to**

1.0      Practice volumetric measurements (using pipettes, measuring jars, volumetric flask, burettes) and gravimetric measurements (using different types of balances), making dilutions, etc. To identify the chemical compounds and solutions by senses.

2.0      Practice making standard solutions with pre weighed salts and to make solutions of desired dilutions using appropriate techniques.

3.0      Conduct titrations adopting standard procedures and using Std. $Na_2CO_3$ solution for estimation of HCl

4.0      Conduct titrations adopting standard procedures and using Std. HCl solution for estimation of NaOH

5.0      Conduct titrations adopting standard procedures and using Std. NaOH solution for estimation of $H_2SO_4$

6.0      Conduct titrations adopting standard procedures and using Std.$KMnO_4$ solution for estimation of Mohr's Salt

7.0      Conduct titrations adopting standard procedures to determine the acidity of given samples of water (One ground water and one surface / tap water, and rain water if available)

8.0      Conduct titrations adopting standard procedures to determine the alkalinity of given samples of water (One ground water and one surface / tap water)

9.0      Conduct titrations adopting standard procedures to determine the total hardness of given samples of water (One ground water and one surface / tap water) using Std. EDTA solution

10.0      Conduct titrations adopting standard procedures to determine the chlorides present in the given samples of water and wastewater (One ground water and one surface / tap water)

11.0      Conduct the test using titrometric / electrometric method to determine Dissolved Oxygen (D.O) in given water samples (One sample from closed container and one from open container / tap water)

12.0      Conduct the test on given samples of water / solutions (like soft drinks, sewage, etc.) to determine their pH using standard pH meter

13.0      Conduct the test on given samples of water / solutions
         a)      To determine conductivity
         b)      To adjust the ionic strength of the sample to the desired value

14.0      Conduct the test on given samples of solutions (coloured and non coloured) to determine their turbidity in NTU

15.0      To determine the total solids present in given samples of water (One ground water and one surface / tap water)

## Competencies and Key competencies to be achieved by the student

| Name of the Experiment (No of Periods) | Competencies | Key competencies |
|---|---|---|
| Familiarization of methods for Volumetric analysis. Recognition of chemical substances And solutions (03) | - | -- |
| Preparation of Std $Na_2CO_3$ and making solutions of different dilution(03) | ▪ Weighing the salt to the accuracy of .01 mg<br>▪ Measuring the water with volumetric flask, measuring jar, volumetric pipette and graduated pipette<br>▪ Making appropriate dilutions | ▪ Weighing the salt to the accuracy of .01 mg<br>▪ Measuring the water with volumetric flask, measuring jar, volumetric pipette and graduated pipette<br>▪ Making appropriate dilutions |
| Estimation of HCl solution using Std. $Na_2CO_3$ solution (03)<br><br>Estimation of NaOH using Std.HCl solution (03)<br><br>Estimation of $H_2SO_4$ using Std.NaOH solution (03)<br><br>Estimation of Mohr's Salt using Std.$KMnO_4$ (03)<br><br>Determination of acidity of water sample (03)<br><br>Determination of alkalinity of water sample (03)<br><br>Determination of total hardness of water using Std. EDTA solution (03)<br><br>Estimation of Chlorides present in water sample (03)<br><br>Estimation of Dissolved Oxygen(D.O) in water sample (By titration method) (03) | ▪ Cleaning the glassware and rinsing with appropriate solutions<br>▪ Making standard solutions<br>▪ Measuring accurately the standard solutions and titrants<br>▪ Filling the burette with titrant<br>▪ Fixing the burette to the stand<br>▪ Effectively Controlling the flow of the titrant<br>▪ Identifying the end point<br>▪ Making accurate observations<br>▪ Calculating the results | ▪ Making standard solutions<br>▪ Measuring accurately the standard solutions and titrants<br>▪ Effectively Controlling the flow of the titrant<br>▪ Identifying the end point<br>▪ Making accurate observations |
| Determination of pH using pH meter (03) | ▪ Familiarize with instrument<br>▪ Choose appropriate 'Mode' / 'Unit'<br>▪ Prepare standard solutions | ▪ Prepare standard solutions / buffers, etc.<br>▪ Standardize the instrument with |

| | | |
|---|---|---|
| Determination of conductivity of water and adjusting ionic strength to required level (03) | / buffers, etc.<br>▪ Standardize the instrument with appropriate standard solutions<br>▪ Plot the standard curve<br>▪ Make measurements accurately<br>▪ Follow Safety precautions | appropriate standard solutions<br>▪ Plot the standard curve<br>▪ Make measurements accurately |
| Determination of turbidity of water (03) | | |
| Estimation of total solids present in water sample (03) | ▪ Measuring the accurate volume and weight of sample<br>▪ Filtering and air drying without losing any filtrate<br>▪ Accurately weighing the filter paper, crucible and filtrate<br>▪ Drying the crucible in an oven | ▪ Measuring the accurate volume and weight of sample<br>▪ Filtering and air drying without losing any filtrate<br>▪ Accurately weighing the filter paper, crucible and filtrate |

SCHEME OF VALUATION

A) Writing Chemicals, apparatus ,principle and procedure   5M
B) Demonstrated competencies                                20M
   Making standard solutions
   Measuring accurately the standard solutions and titrants
   Effectively controlling the flow of the titrant
   Identifying the end point
   Making accurate observations
C) Viva-voce                                                5M
                                                    --------------
                        Total               30M

# COMPUTER FUNDAMENTALS LAB PRACTICE

| Course code | Course Title | No. of Periods/Weeks | Total No. of periods | Marks for FA | Marks for SA |
|---|---|---|---|---|---|
| M-111 (common to all branches) | Computer Fundamentals Lab Practice | 3 | 90 | 40 | 60 |

**Time schedule:**

| S.No. | Chapter/Unit Title | No. of sessions each of 3 periods duration | No. of Periods |
|---|---|---|---|
| 1. | Computer hardware Basics | 2 | 6 |
| 2. | Windows Operating System | 2 | 6 |
| 3. | MS Word | 8 | 24 |
| 4. | MS Excel | 7 | 21 |
| 5. | MS PowerPoint | 5 | 15 |
| 6. | Adobe Photoshop | 6 | 18 |
| | **Total periods** | **30** | **90** |

| S.No. | Chapter/Unit Title | No. of Periods | CO's Mapped |
|---|---|---|---|
| 1. | Computer hardware Basics | 6 | CO1 |
| 2. | Windows Operating System | 6 | CO1 |
| 3. | MS Word | 24 | CO2 |
| 4. | MS Excel | 21 | CO3 |
| 5. | MS PowerPoint | 15 | CO4 |
| 6 | Adobe Photoshop | 18 | CO5 |
| | **Total periods** | **90** | |

| Course Objectives | i)To know Hardware Basics<br>ii)To familiarize operating systems<br>iii)To use MS Office effectively to enable to students use these skills in future courses<br>iv) To use Adobe Photoshop in image editing. |
|---|---|

| | | At the end of the course students will be able to | |
|---|---|---|---|
| **Course Outcomes** | CO1 | M-110.1 | Identify hardware and software components |
| | CO2 | M-110.2 | Prepare documents with given specifications using word processing software |
| | CO3 | M-110.3 | Use Spread sheet software to make calculation and to draw various graphs / charts. |
| | CO4 | M-110.4 | Use Power point software to develop effective presentation for a given theme or topic. |
| | CO5 | M-110.5 | Edit digital or scanned images using Photoshop |

**Learning Outcomes:**

**I. Computer Hardware Basics**
1. a).To Familiarize with Computer system and hardware connections
   b).To Start and Shut down Computer correctly
   c).To check the software details of the computer
2. To check the hardware present in your computer

**II. Windows's operating system**
3. To Explore Windows Desktop
4. Working with Files and Folders
5. Windows Accessories: Calculator – Notepad – WordPad – MS Paint

**III. Practice with MS-WORD**
6. To familiarize with Ribbon layout of MS Word
    Home – Insert- Page layout – References – Review- View.
7. To practice Word Processing Basics
8. To practice Formatting techniques
9. To insert a table of required number of rows and columns
10. To insert Objects, Clipart and Hyperlinks
11. To use Mail Merge feature of MS Word
12. To use Equations and symbols features

**IV. Practice with MS-EXCEL**
13. To familiarize with MS-EXCEL layout
14. To access and enter data in the cells
15. To edit a spread sheet- Copy, Cut, Paste, and selecting Cells
16. To use built in functions and Formatting Data
17. To create Excel Functions, Filling Cells
18. To enter a Formula for automatic calculations
19. To sort and filter data in table.
20. To present data using Excel Graphs and Charts.
21. To develop lab reports of respective discipline.
22. To format a Worksheet in Excel, Page Setup and Print

**V. Practice with MS-POWERPOINT**
23. To familiarize with Ribbon layout features of PowerPoint 2007.
24. To create a simple PowerPoint Presentation
25. To set up a Master Slide in PowerPoint
26. To insert Text and Objects
27. To insert a Flow Charts
28. To insert a Table
29. To insert a Charts/Graphs
30. To insert video and audio
31. To practice Animating text and objects
32. To Review presentation

**VI. Practice with Adobe Photoshop**
33.To familiarize with standard toolbox
34. To edit a photograph.

35. To insert Borders around photograph.
36. To change Background of a Photograph.
37. To change colors of Photograph.
38. To prepare a cover page for the book in your subject area.
39. To adjust the brightness and contrast of the picture so that it gives an elegant look.
40. To type a word and apply the shadows emboss effects.

**Key competencies:**

| Expt No | Name of Experiment | Competencies | Key competencies |
|---------|--------------------|--------------|------------------|
| 1 (a). | To familiarize with Computer system and hardware connections | a. Identify the parts of a Computer system: i). CPU ii). Mother Board iii) Monitor iv) CD/DVD Drive v) Power Switch vi) Start Button vii) Reset Button<br>b. Identify and connect various peripherals<br>c. Identify and connect the cables used with computer system<br>d. Identify various ports on CPU and connect Keyboard & Mouse | Connect cables to external hardware and operate the computer |
| 1 (b). | To Start and Shut down Computer correctly | a. Log in using the password<br>b. Start and shut down the computer<br>c. Use Mouse and Key Board | a. Login and logout as per the standard procedure<br>b. Operate mouse &Key Board |
| 1 (c). | To Explore Windows Desktop | a. Familiarize with Start Menu, Taskbar, Icons and Shortcuts<br>b. Access application programs using Start menu, Task manager<br>c. Use Help support | a. Access application programs using Start menu<br><br>b. Use taskbar and Task manager |
| 2. | To check the software details of the computer | a. Find the details of Operating System being used<br>b. Find the details of Service Pack installed | Access the properties of computer and find the details |
| 3. | To check the hardware present in your computer | a.Find the CPU name and clock speed<br>b.Find the details of RAM and Hard disk present<br>c.Access Device manager using Control Panel and check the status of devices like mouse and key board<br>d. Use My Computer to check the details of Hard | a. Access device manager and find the details<br>b. Type /Navigate the correct path and Select icon related to the details required |

| | | drives and partitions<br>e.    Use the Taskbar | |
|---|---|---|---|
| 4. | Working with Files and Folders | a.    Create folders and organizing files in different folders<br><br>b.    Use copy / paste move commands to organize files and folders | a. Create files and folders Rename , arrange and search<br>for the required folder/file |
| | Working with Files and Folders Continued.... | c.Arrange icons – name wise, size, type, Modified<br>d.    Search a  file or folder and find its path<br>e.    Create  shortcut to files and folders (in other folders) on Desktop<br>f. Familiarize with the   use of My Documents<br>g.    Familiarize    with    the use of Recycle Bin | b. Restore deleted files from Recycle bin |
| 5. | To use Windows Accessories: Calculator – Notepad – WordPad – MS Paint | a.    Familiarize with the use of  Calculator<br>b.    Access    Calculator using Run  command<br>c.Create  Text  Files  using Notepad and  WordPad and observe the difference in file size<br>d.    Use    MS    paint    and create  .jpeg,  .bmp  files using MS Paint | a. Use windows accessories and select correct text editor based on the situation.<br><br>b. Use MS pain to create /Edit pictures and save in the required format. |
| 6. | To familiarize with Ribbon layout of MS word. –  Home – Insert-page layout- References-Review-View | a.    Create/Open    a document<br>b.    Use Save and Save as features<br>c.Work    on    two    Word documents simultaneously<br>d.    Choose correct  Paper size and Printing options | a. Create a Document and name appropriately and save<br>b. Set paper size and print options |
| 7. | To practice Word Processing Basics | a.    Typing text<br>b.    Keyboard usage<br>c.Use  mouse (Left click  / Right click / Scroll)<br>d.    Use    Keyboard shortcuts<br>e.    Use  Find and Replace features in MS- word<br>f. Use   Undo    and    Redo Features<br>g.    Use   spell   check   to correct    Spellings    and Grammar | a. Use key board and mouse to enter/edit text in the document.<br>b. Use shortcuts<br>c. Use spell check/ Grammar features for auto corrections. |

| | | | |
|---|---|---|---|
| 8. | To practice Formatting techniques | a. Formatting Text<br>b. Formatting Paragraphs<br>c. Setting Tabs<br>d. Formatting Pages<br>e. The Styles of Word<br>f. Insert bullets and numbers<br>g. Themes and Templates<br>h. Insert page numbers, header and footer | a. Format Text and paragraphs and use various text styles.<br>b. Use bullets and numbers to create lists<br>c. Use Templates /Themes<br>d. Insert page numbers date, headers and footers |
| 9. | To insert a table of required number of rows and columns | a. Edit the table by adding the fields – Deleting rows and columns –inserting sub table –marking borders. Merging and splitting of cells in a Table<br>b. Changing the background colour of the table<br>c. Use table design tools<br>d. Use auto fit – fixed row/ column height/length – Even distribution of rows / columns features<br>e. Convert Text to table and Table to Text<br>f. Use Sort feature of the Table to arrange data in ascending/descending order | a. Insert table in the word document and edit<br>b. Use sort option for arranging data. |
| 10. | To Insert objects, clipart and Hyperlinks | a. Create a 2-page document. &Insert hyperlinks and t Bookmarks.<br>b. Create an organization chart<br>c. Practice examples like preparing an Examination schedule notice with a hyperlink to Exam schedule table. | a. Insert hyperlinks &Bookmarks<br>b. Create organization charts/flow charts |
| 11. | To Use Mail merge feature of MS Word | a. Use mail merge to prepare individually addressed letters<br>b. Use mail merge to print envelopes. | Use Mail merge feature |
| 12. | To use Equations and symbols features. | a. Explore various symbols available in MS Word<br>b. Insert a symbol in the text | Enter Mathematical symbols and Equations in the word document |

| | | c.Insert mathematical equations in the document | |
|---|---|---|---|
| 13. | To Practice with MS-EXCEL | a.Open /create an MS Excel spreadsheet and familiarize with MS Excel 2007 layout like MS office Button- b.Use Quick Access Toolbar-Title Bar- Ribbon-Worksheets- Formula Bar-Status Bar | a. Familiarize with excel layout and use b. Use various features available in toolbar |
| 14. | To access and Enter data in the cells | a. Move Around a Worksheets-Quick access - Select Cells b. Enter Data-Edit a Cell-Wrap Text-Delete a Cell Entry-Save a File-Close Excel | a. Access and select the required cells by various addressing methods b. Enter data and edit |
| 15. | To edit spread sheet Copy, Cut, Paste, and selecting cells | a. Insert and Delete Columns and Rows-Create Borders-Merge and Center b. Add Background Color-Change the Font, Font Size, and Font Color c.Format text with Bold, Italicize, and Underline-Work with Long Text-Change a Column's Width | Format the excel sheet |
| 16. | To use built in functions and Formatting Data | a. Perform Mathematical Calculations verify - AutoSum b. Perform Automatic Calculations-Align Cell Entries | Use built in functions in Excel |
| 17. | To enter a Formula for automatic calculations | a. Enter formula b. Use Cell References in Formulae c.Use Automatic updating function of Excel Formulae d. Use Mathematical Operators in Formulae e. Use Excel Error Message and Help | Enter formula for automatic calculations |
| 18. | To Create Excel Functions, Filling Cells | a. Use Reference Operators b. Work with sum, Sum if , Count and Count If Functions c. Fill Cells Automatically | a. Create Excel sheets involving cross references and equations b. Use the advanced functions for conditional calculations |

| 19. | To sort and filter data in table | a. Sort data in multiple columns<br>b. Sort data in a row<br>c. Sort data using Custom order<br>d. Filter data in work sheet | a. Refine the data in a worksheet and keep it organized<br>b. Narrow a worksheet by selecting specific choice |
|---|---|---|---|
| 20. | To Practice Excel Graphs and Charts | a. Produce an Excel Pie Chart<br>b. Produce<br>c. Excel Column Chart | a. Use data in Excel sheet to Create technical charts and<br><br>graphs Produce Excel Line Graph<br>b. Produce a Pictograph in Excel |
| 21. | To develop lab reports of respective discipline | Create Lab reports using MS Word and Excel | a. Insert Practical subject name in Header and page numbers in Footer |
| 22. | To format a Worksheet in Excel, page setup and print | a. Shade alternate rows of data<br>b. Add currency and percentage symbols<br>c. Change height of a row and width of a column<br>d. Change data alignment<br>e. Insert Headers and Footers<br>f. Set Print Options and Print | a. Format Excel sheet<br>b. Insert headers &footers and print |
| 23. | To familiarize with Ribbon layout &features of PowerPoint 2007. | Use various options in PowerPoint<br>a. Home<br>b. Insert<br>c. Design<br>d. Animation<br>e. Slideshow<br>f. View<br>g. Review | Access required options in the tool bar |
| 24. | To create a simple PowerPoint Presentation | a. Insert a New Slide into PowerPoint<br>b. Change the Title of a PowerPoint Slide<br>c. PowerPoint Bullets<br>d. Add an Image to a PowerPoint Slide<br>e. Add a Textbox to a PowerPoint slide | a. Create simple PowerPoint presentation with photographs/Clip Art and text boxes<br>b. Use bullets option |
| 25. | To Set up a Master Slide in PowerPoint and add notes | a. Create a PowerPoint Design Template<br>b. Modify themes<br>c. Switch between Slide | a. Setup Master slide and format<br>b. Add notes |

| | | | |
|---|---|---|---|
| | | master view and Normal view<br>d.  Format a Design Template Master Slide<br>e.  Add a Title Slide to a Design Template<br>f.  The Slide Show Footer in PowerPoint<br>g.  Add Notes to a PowerPoint Presentation | |
| 26. | To Insert Text and Objects | a.  Insert Text and objects<br>b.  Set Indents and line spacing<br>c.  Insert  pictures/ clipart<br>d.  Format pictures<br>e.  Insert shapes and word art<br>f.  Use 3d features<br>g.  Arrange objects | Insert Text and Objects<br>Use 3d features |
| 27. | To insert a Flow Chart / Organizational Charts | a.  Create a Flow Chart in PowerPoint<br>b.  Group and Ungroup Shapes<br>c.  Use smart art | Create organizational charts and flow charts using smart art |
| 28. | To insert a Table | a.  PowerPoint Tables<br>b.  Format the Table Data<br>c.  Change Table Background<br>d.  Format Series Legend | Insert tables and format |
| 29. | To insert a Charts/Graphs | a.  Create 3D Bar Graphs in PowerPoint<br>b.  Work with the PowerPoint Datasheet<br>c.  Format a PowerPoint Chart Axis<br>d.  Format the Bars of a Chart<br>e.  Create PowerPoint Pie Charts<br>f.  Use Pie Chart Segments<br>g.  Create 2D Bar Charts in PowerPoint<br>h.  Format the 2D Chart<br>e.  Format a Chart Background | Create charts and Bar graphs, Pie Charts and format. |
| 30. | To  Insert audio & video, Hyperlinks  in a slide<br>Add narration to the slide | a.  Insert sounds in the slide and hide the audio symbol<br><br>b.  Adjust the volume in the settings<br>c.  Insert video file in the format supported by PowerPoint in a slide<br>d.  Use automatic and on click options<br>e.  Add narration to the slide<br>f.  Insert Hyperlinks | a.  Insert Sounds and Video in appropriate format.<br>b.  Add narration to the slide<br>c.  Use hyperlinks to switch to different slides and files |

| 31. | To Practice Animation effects | a. Apply transitions to slides<br>b. To explore and practice special animation effects like Entrance, Emphasis, Motion Paths &Exit | Add animation effects |
|---|---|---|---|
| 32. | Reviewing presentation | a. Checking spelling and grammar<br>b. Previewing presentation<br>c. Set up slide show<br>d. Set up resolution<br>e. Exercise with Rehearse Timings feature in PowerPoint<br>f. Use PowerPoint Pen Tool during slide show<br>g. Saving<br>h. Printing presentation<br>  (a) Slides<br>  (b) Hand-out | a. Use Spell check and Grammar feature<br>b. Setup slide show<br>c. Add timing to the slides<br>d. Setup automatic slide show |
| 33 | To familiarize with standard toolbox | a. Open Adobe Photoshop<br>b. Use various tools such as<br>  i. The Layer Tool<br>  ii. The Color & Swatches Tool<br>  iii. Custom Fonts & The Text Tool<br>  iv. Brush Tool<br>  v. The Select Tool<br>  vi. The Move Tool<br>  vii. The Zoom Tool<br>  viii. The Eraser<br>  ix. The Crop Tool<br>  x. The Fill Tool | Open a photograph and save it in Photoshop |
| 34 | To edit a photograph | a. Use the Crop tool<br>b. Trim edges<br>c. Change the shape and size of a photo<br>d. Remove the part of photograph including graphics and text | a. Able to edit image by using corresponding tools. |
| 35 | To insert Borders around photograph | a. Start with a single background layer<br>b. Bring the background forward<br>c. Enlarge the canvas<br>d. Create a border color<br>e. Send the border color to the back<br>f. Experiment with different colors | Able to create a border or frame around an image to add visual interest to a photo |
| 36 | To change Background of a Photograph | a. open the foreground and background image<br>b. Use different selection tools to paint over the image | Able to swap background elements using the Select and Mask |

| | | c. Copy background image and paste it on the foreground.<br>d. Resize and/or drag the background image to reposition.<br>e. In the Layers panel, drag the background layer below the foreground image layer. | tool and layers. |
|---|---|---|---|
| 37 | To change colors of Photograph | a. Change colors using:<br>i) Color Replacement tool<br>ii) **Hue/Saturation adjustment layer tool** | Able to control color saturation |
| 38 | To prepare a cover page for the book in subject area | a. open a file with height 500 and width 400 for the cover page.<br>b. apply two different colors to work area by dividing it into two parts using Rectangle tool.<br>c. Copy any picture and place it on work area→ resize it using free transform tool.<br>d. Type text and apply color and style<br>e. Apply effects using blended options | Able to prepare cover page for the book |
| 39 | To adjust the brightness and contrast of picture to give an elegant look | a. open a file.<br>b. Go to image→ adjustments→ Brightness/Contrast.<br>c. adjust the brightness and contrast.<br>d. Save the image. | Able to control brightness/contrast. |
| 40 | To type a word and apply the shadow emboss effects | a. open a file<br>b. Select the text tool and type text.<br>c. Select the typed text go to layer→ layer style→ blended option→ drop shadow, inner shadow, bevel and emboss→ contour→ satin→ gradient overlay<br>d. Save the image. | Able to apply shadow emboss effects |

## Table specifying the scope of syllabus to be covered for unit tests

| Unit Test | Learning outcomes to be covered |
|---|---|
| Unit test-1 | From 1 to 8 |
| Unit test-2 | From 9 to 22 |
| Unit test-3 | From 23 to 40 |

# III SEMESTER

# DIPLOMA IN MECHANICAL ENGINEERING
## SCHEME OF INSTRUCTIONS AND EXAMINATIONS
### III Semester

| Course Code | Course Title | Instruction period / week | | Total Period / year | Scheme of Examination | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Practical/Tutorial | | Duration (hours) | Sessional Marks | End Exam Marks | Total Marks |
| THEORY | | | | | | | | |
| M- 301 | Engineering Mathematics - II | 4 | - | 60 | 3 | 20 | 80 | 100 |
| M -302 | Engineering Materials | 4 | - | 60 | 3 | 20 | 80 | 100 |
| M -303 | Basic Electrical& Electronics Engineering | 4 | - | 60 | 3 | 20 | 80 | 100 |
| M-304 | Basic Thermodynamics | 4 | - | 60 | 3 | 20 | 80 | 100 |
| M-305 | Strength of Materials | 4 | - | 60 | 3 | 20 | 80 | 100 |
| M-306 | Production Technology-I | 4 | - | 60 | 3 | 20 | 80 | 100 |
| PRACTICAL | | | | | | | | |
| M-307 | Machine Drawing | - | 6 | 90 | 3 | 40 | 60 | 100 |
| M-308 | Material Testing and Metallography Lab Practice | - | 3 | 45 | 3 | 40 | 60 | 100 |
| M-309 | Fuels Laboratory Practice | | 3 | 45 | 3 | 40 | 60 | 100 |
| M-310 | Electrical Engineering Lab Practice | - | 3 | 45 | 3 | 40 | 60 | 100 |
| M-311 | Workshop Practice -I | - | 3 | 45 | 3 | 40 | 60 | 100 |
| TOTAL | | 24 | 18 | 630 | | 320 | 780 | 1100 |

# ENGINEERING MATHEMATICS-II

| Course Code | Course Title | No. of Periods/week | Total No. of periods | Marks for FA | Marks for SA |
|---|---|---|---|---|---|
| C-301 | Engineering Mathematics-II | 4 | 60 | 20 | 80 |

| S.No. | Unit Title | No. of periods | COs mapped |
|---|---|---|---|
| 1 | Indefinite Integration | 22 | CO1 |
| 2 | Definite Integration and its applications | 24 | CO2 |
| 3 | Differential Equations of first order | 14 | CO3 |
| | **Total Periods** | **60** | |

| | | |
|---|---|---|
| **Course Objectives** | (i) | To understand the concepts of indefinite integrals and definite integrals with applications to engineering problems. |
| | (ii) | To understand the formation of differential equations and learn various methods of solving them. |

| | | |
|---|---|---|
| **Course Outcomes** | CO1 | Integrate various functions using different methods. |
| | CO2 | Evaluate definite integrals with applications. |
| | CO3 | Obtain differential equations and solve differential equations of first order and first degree. |

## ENGINEERING MATHEMATICS – II
### Learning Outcomes

**Unit-I**
**C.O. 1 Integrate various functions using different methods.**
**L.O.** 1.1. Explain the concept of Indefinite integral as an anti-derivative.

1.2. State the indefinite integral of standard functions and properties of Integrals $\int (u + v)\, dx$ and $\int ku\, dx$ where $k$ is constant and $u, v$ are functions of $x$.

1.3. Solve integration problems involving standard functions using the above rules.

1.4. Evaluate integrals involving simple functions of the following type by the method of substitution.

i) $\int f(ax + b)\, dx$ where $f(x)dx$ is in standard form.

ii) $\int [f(x)]^n\, f'(x)\, dx$

iii) $\int f'(x)/[f(x)]\, dx$

iv) $\int f\{g(x)\}\, g'(x)\, dx$

1.5. Find the integrals of *tan x, cot x, sec x* and *cosec x* using the above.

1.6. Evaluate the integrals of the form $\int sin^m x\, cos^n x\, dx$ where m and n are suitable positive integers.

1.7. Evaluate integrals of suitable powers of *tan x* and *sec x*.

1.8. Evaluate the Standard integrals of the functions of the type

$i) \dfrac{1}{a^2+x^2}, \dfrac{1}{a^2-x^2}, \dfrac{1}{x^2-a^2}$

$ii) \dfrac{1}{\sqrt{a^2+x^2}}, \dfrac{1}{\sqrt{a^2-x^2}}, \dfrac{1}{\sqrt{x^2-a^2}}$

$iii) \sqrt{x^2-a^2}, \sqrt{x^2+a^2}, \sqrt{a^2-x^2}$

1.9. Evaluate the integrals of the type

$$\int \frac{1}{a+bSin\theta}d\theta, \int \frac{1}{a+b\cos\theta}d\theta \text{ and } \int \frac{1}{a\cos\theta+b\sin\theta+c}d\theta .$$

1.10. Evaluate integrals using decomposition method.

1.11. Solve problems using integration by parts.

1.12 Use Bernoulli's rule for evaluating the integrals of the form $\int u.v dx$.

1.13. Evaluate the integrals of the form $\int e^x [f(x) + f'(x)]\, dx.$

**Unit-II**

**C.O.2 Evaluate definite integrals with applications.**

L.O.2.1. State the fundamental theorem of integral calculus

2.2. Explain the concept of definite integral.

2.3. Solve problems on definite integrals over an interval using the above concept.

2.4. State various properties of definite integrals.

2.5. Evaluate simple problems on definite integrals using the above properties.

Syllabus for Unit test-I completed

2.6. Explain definite integral as a limit of sum by considering an area.

2.7. Find the areas under plane curves and area enclosed between two curves using integration.

2.8. Obtain the mean value and root mean square value of the functions in any given interval.

2.9. Obtain the volumes of solids of revolution.

2.10. Solve some problems using Trapezoidal rule, Simpson's 1/3 rule for approximation of integrals.

**Unit -III**

**C.O. 3 Form differential equations and solve differential equations of first order and first degree.**

**L.O.** 3.1 Define a Differential equation, its order and degree

3.2 Find order and degree of a given differential equation.

3.3 Form a differential equation by eliminating arbitrary constants.

3.4 Solve the first order and first degree differential equations by variables separable method.

3.5 Solve Homogeneous differential equation of first order and first degree.

3.6 Solve exact differential equation of first order and first degree.

3.7 Solve linear differential equation of the form dy/dx + Py = Q, where P and Q are functions of x or constants.

3.8 Solve Bernoulli's differential equation reducible to linear form.

3.9 Solve simple problems arising in engineering applications.

Syllabus for Unit test-II completed

# ENGINEERING MATHEMATICS – II
## COURSE CONTENTS

**Unit-I**
**Indefinite Integration.**
**1.** Integration regarded as anti-derivative – Indefinite integrals of standard functions. Properties of indefinite integrals. Integration by substitution or change of variable. Integrals of tan x, cot x, sec x, cosec x. Integrals of the form $\int \sin^m x . \cos^n x \, dx$, where at least one of m and n is odd positive integers. Integrals of suitable powers of tanx. secx and cosecx.cotx by substitution.

Evaluation of integrals which are reducible to the following forms:

$$i) \frac{1}{a^2+x^2}, \frac{1}{a^2-x^2}, \frac{1}{x^2-a^2}$$

$$ii) \frac{1}{\sqrt{a^2+x^2}}, \frac{1}{\sqrt{a^2-x^2}}, \frac{1}{\sqrt{x^2-a^2}}$$

$$iii) \sqrt{x^2-a^2}, \sqrt{x^2+a^2}, \sqrt{a^2-x^2}$$

Integration by decomposition of the integrand into simple rational, algebraic functions.

Integration by parts, Bernoulli's rule and integrals of the form $\int e^x [f(x) + f'(x)] \, dx$.

**Unit-II**
**Definite Integral and its applications:**
2. Definite integral-fundamental theorem of integral calculus, properties of definite integrals,

evaluation of simple definite integrals. Definite integral as the limit of a sum. Area under plane curves – Area enclosed between two curves. Mean and RMS values of a function on a given interval Volumes of solids of revolution. Trapezoidal rule, Simpson's 1/3 rule to evaluate an approximate value of a define integral.

**Unit -III**
**Differential Equations:**
3. Definition of a differential equation-order and degree of a differential equation-formation of differential equations-solutions of differential equations of first order and first degree using methods, variables separable, homogeneous, exact, linear differential equation, Bernoulli's equation.

**Textbook:**
Engineering Mathematics-II, a textbook for third semester diploma courses, prepared & prescribed by SBTET, AP.

**Reference Books:**
1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
2. Schaum's Outlines Differential Equations, Richard Bronson & Gabriel B. Costa
3. M.Vygodsky, Mathematical Handbook: Higher Mathematics, Mir Publishers, Moscow.

# BLUE PRINT

| S.No | Chapter/Unit title | No of Periods | Weight age allotted | Marks wise distribution of weight age | | | | Question wise distribution of weight age | | | | COs mapped |
|------|---------------------|---------------|---------------------|---|---|---|---|---|---|---|---|------|
| | | | | R | U | Ap | An | R | U | Ap | An | |
| 1 | Unit – I: Indefinite Integration | 22 | 28 | 11 | 11 | 06 | 0 | 2 | 2 | 2 | 0 | CO1 |
| 2 | Unit – II: Definite Integration and its applications | 24 | 33 | 11 | 03 | 11 | 08 | 2 | 1 | 2 | 1 | CO2 |
| 3 | Unit – III: Differential Equations of first order | 14 | 19 | 03 | 03 | 03 | 10 | 1 | 1 | 1 | 1 | CO3 |
| | Total | 60 | 80 | 25 | 17 | 20 | 18 | 5 | 4 | 5 | 2 | |

R: Remembering Type    : 25 Marks
U: understanding Type  : 17 Marks
Ap: Application Type    : 20 Marks
An: Analysing Type     : 18 Marks

## Engineering Mathematics – II
## Unit Test Syllabus

| Unit Test | Syllabus |
|-----------|----------|
| Unit Test-I | From L.O 1.1 to L.O 2.5 |
| Unit Test-II | From L.O 2.6 to L.O 3.9 |

# ENGINEERING MATERIALS

| Course Title | Course Code | Periods per week | Periods per Semester |
|---|---|---|---|
| Engineering Materials | M-302 | 04 | 60 |

## TIME SCHEDULE

| S. No | Chapter/Unit Title | No. of Periods | Weightage of Marks | Short Answer Questions (3 M) | Essay Type Questions (8M) | Essay Type Question (10M) |
|---|---|---|---|---|---|---|
| 1 | Introduction to Engineering materials | 12 | 17 | 3 | 1 | |
| 2 | Structure of Materials | 08 | 11 | 1 | 1 | |
| 3 | Production of Iron and Steel | 10 | 11 | 1 | 1 | 1 |
| 4 | Phase Diagrams and Heat treatment of Steel | 20 | 17 | 3 | 1 | |
| 5 | Ferrous, Non-Ferrous Metals and their alloys | 10 | 14 | 2 | 1 | |
| | **Total** | **60** | **70+10** | **10** | **5** | **1** |

**Note: 10 Marks higher order question may be given from the Chapter -3 or 4 or 5.**

## Course Objectives and Course Outcomes

| | | | |
|---|---|---|---|
| **Course Objectives** | *Upon completion of the course the student shall be able to*<br><br>Understand the mechanical properties and analyse the testing of materials, atomic structure of materials and phase transformation in iron carbon equilibrium, production of iron and steel and heat treatment methods. | | |
| **Course Outcomes** | CO1 | M-302.1 | Explain the procedure to find the mechanical properties of the materials by destructive and non-destructive tests |
| | CO2 | M-302.2 | Explain the microstructure of materials. |
| | CO3 | M-302.3 | Describe iron and steel production processes |
| | CO4 | M-302.4 | Discuss the iron-iron carbide equilibrium diagram and heat treatment processes |
| | CO5 | M-302.5 | Explain the 1. classification, 2.composition and 3.properties of Ferrous, Non-Ferrous Metals and their alloys |

**MODEL Blue Print of Question Paper**

| S. No | Chapter Name | Periods Allocated | Weight age Allocated | Marks Wise Distribution of Weightage | | | | Question Wise Distribution of Weightage | | | | CO's Mapped |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | R | U | Ap | An | R | U | Ap | An | |
| 1 | Introduction to Engineering materials | 12 | 17 | 9 | 8 | | | 3 | | 1 | | CO1 |
| 2 | Structure of Materials | 08 | 11 | 3 | 8 | | | 1 | | 1 | | CO2 |
| 3 | Production of Iron and Steel | 10 | 11 | 3 | 8 | | | 1 | | 1 | | CO3 |
| 4 | Phase Diagrams and Heat treatment of Steel | 20 | 27 | 9 | 8 | | 10 | 3 | | 1 | 1 | CO4 |
| 5 | Ferrous, Non-Ferrous Metals and their alloys | 10 | 14 | 6 | 8 | | | 2 | | 1 | | CO5 |
| | TOTAL | 60 | 80 | 30 | 40 | | 10 | 10 | | 5 | 1 | |

**Note:  10 Marks higher order question may be given from Chapter - 3 or 4 or 5 (Here It is taken from chapter – 4)**

**Learning Outcomes**
 Upon completion of the course the student shall be able to

**1.0  Introduction of engineering materials**
1.1  Classify the engineering materials as metals, non-metals, composites
1.2  List the Constituents in composites and types of reinforcements.
 1.3  List the various engineering materials and their applications.
 1.4  State the importance of  various Engineering Materials used in
       Mechanical processes/industries.
1.5  Define the following Properties. i)  Tensile, compressive and shear strength
       ii) Ductility iii) Hardness iv) Toughness v) Brittleness vi) Impact strength
       vii) Fatigue and viii) Creep Resistance.
1.6  Introduction to Testing of materials
1.7  Differentiate between destructive and non-destructive tests.
1.8  Describe the testing procedure for tensile strength, compression strength,
       shear strength, Impact strength, and hardness of metals.
1.9  Describe the procedure for Testing Materials by X-Ray, gamma–Ray,
       magnetic flux, Ultrasonic and penetrant test.

**2.0  Structure of materials**
2.1  State the meaning of space lattice.
2.2  Define unit cell.
2.3  Describe the three main types of space lattice.

2.4   Explain the formation of grains by dendrite growth.
2.5   Explain the effect of rate of cooling on grain formation.
2.6   Explain the effect of grain size on mechanical properties.
2.7   Identify two factors promoting grainsize.
2.8   Identify the three stages in the phenomenon of recrystallization of cold worked components.

## 3.0   Production of Iron and Steel
3.1   Name the various raw materials required for production of iron.
3.2   Describe the method of producing Pig Iron in Blast furnace.
3.3   Describe the puddling furnace to produce wrought iron.
3.4   Explain the process of manufacturing cast iron in Cupola.
3.5   Describe the manufacturing of steel by Bessemer process, L.D. process, Open Hearth and Electric Process.

## 4.0   Phase Diagrams and Heat treatment of Steel
4.1   Explain the cooling curves of pure metal.
4.2   Mention the allotropic forms of pure iron with temperatures and their crystal structures.
4.3   Draw the iron carbon equilibrium diagram, identify various structures of the iron carbon system.
4.4   Locate Eutectic, Peritectic and Eutectoid points on the Iron Carbon equilibrium diagram.
4.5   Calculate the composition of phases in a steel/cast Iron from the iron carbon equilibrium diagram.
4.6   State the importance of heat treatment for steels.
4.7   Describe the main features of the various heat treatment operations.
4.8   Differentiate annealing and normalising.
4.9   Describe the effect of cooling rate in hardening.
4.10 State the importance of tempering.
4.11 Explain use of case hardening processes like; carburizing, nitriding and Cyaniding.

## 5.0   Ferrous, Non-Ferrous Metals and their alloys
5.1   Explain the composition, properties and applications of Cast Iron–Grey, White, Malleable, and Spheroidal.
5.2   State the basis of classification of plain carbon steels.
5.3   List out any five application of these steels.
5.4   Describe the need for alloying the steel with other elements.
5.5   State the composition, properties, and industrial applications of alloy steels.
5.6   Identify the need for non-ferrous metals and their alloys in engineering application.
5.7   Describe the properties and applications of –Copper, Aluminium, Tin, Zinc, Lead, Nickel, Magnesium and Chromium.
5.8   Write the composition, properties and industrial application of Copper and Aluminium alloys.
5.9   List the properties of bearing metals.

**COURSE CONTENT**

1.0 **Introduction to engineering materials**

Classification of engineering materials – Metals (ferrous, non-ferrous), non-metals (polymers, ceramics), Composites (Metal matrix composites, polymer matrix composites, ceramic matrix composites, Nano composites). Constituents in composites (matrix, reinforcement), Different types of reinforcements. A few Mechanical Engineering Materials, Importance of their study with applications. Various mechanical properties of engineering materials – Tensile strength, Compressive strength, Ductility, Malleability, Hardness, Toughness, Brittleness, Impact strength, Fatigue, Creep resistance

Introduction to Testing of materials - Differentiate between destructive and non-destructive tests. Destructive testing tests on UTM to determine tensile, shear strengths – Hardness Tests on Brinell & Rockwell testing machines – Impact test on Izod & Charpy testing machines. Non-destructive testing – Procedure for testing materials by X-ray, gamma ray, magnetic flux and ultrasonic testing and Penetrant test.

2.0 **Structure of Materials**

Space lattices, Unit cell, three main types of metallic space lattices, namely Face Centered Cubic, Body Cantered Cubic, Hexagonal Close Packed. Crystallization of metal, formation of grains by dendrite growth, grain boundary, grain size control, effect of grain size on properties–factors.

3.0 **Production of Iron and Steel**

Raw materials, iron ores, Lime stone, Coal-their availability in India, General Survey of Iron and steel making in India. Manufacturing of pig iron from blast furnace. Wrought iron by pudding furnace. Cast Iron from cupola. Production of steel by Bessemer, L.D. process; Open hearth and Electric processes.

4.0 **Phase Diagrams and Heat treatment of Steel**

Cooling curve for pure metal. Allotropic forms of pure Iron. Iron carbon equilibrium diagram. Importance of heat treatment. Heat treatment processes – annealing, normalizing, hardening, tempering, carburizing, nitriding and cyaniding.

5.0 **Ferrous, Non-Ferrous metals and their alloys**

Classification of Cast Iron – Grey, White, Malleable, Spheroidal – Composition, properties and applications. Plain Carbon Steels: Effect of carbon in steels, Soft, Mild, Medium and High carbon and also their properties and applications. Alloy Steels: Nickel Steels, Chromium steels, 18/8stainless steel, High Speed Steels, Manganese Steel. Properties and uses of Copper, Aluminum, Tin, Zinc, Lead, Nickel, Magnesium and Chromium, Copper and Aluminum alloys- Properties of bearing metals, Babbit metals.

| REFERENCEBOOKS | | |
|---|---|---|
| Material Science d Engineering | by | Raghavan (PHI) |
| Introduction to Physical Metallurgy | by | Sidne H Avner (Tata McGraw Hill) |
| Material science and metallurgy | | O.P. Khanna ( Dhanpat rai publishers |

# BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

| Course Code | Course Title | No. of periods / Week | Total No. of Periods | Marks for FA | Marks for SA |
|---|---|---|---|---|---|
| M303 | BASIC ELECTRICAL AND ELECTRONICS ENGINEERING | 4 | 60 | 20 | 80 |

## TIME SCHEDULE

| S.No | Chapter/ Unit Title | Periods | Weightage Allocated | Short Answer Questions (3 M) | Essay Type Questions (8M) | Higher Order Question (10M) |
|---|---|---|---|---|---|---|
| 1 | Electrical Engineering Fundamentals | 14 | 14 | 2 | 1 | |
| 2 | Electrical Machines | 16 | 14 | 2 | 1 | |
| 3 | Electrical Measuring Instruments | 10 | 14 | 2 | 1 | 1 |
| 4 | Electrical Safety Procedures | 10 | 14 | 2 | 1 | |
| 5 | Electronic Devices | 10 | 14 | 2 | 1 | |
| | **Total** | **60** | **70+10** | **10** | **05** | **1** |

**Note: 10 Marks Higher Order question may be given from the chapter - 1, or 2 or 3 or 4 or 5.**

## COURSE OUTCOMES MAPPING

| S.No | Chapter/Unit Title | No. of periods | CO's Mapped |
|---|---|---|---|
| 1. | Electrical Engineering Fundamentals | 14 | CO1 |
| 2. | Electrical Machines | 16 | CO2 |
| 3. | Electrical Measuring Instruments | 10 | CO3 |
| 4 | Electrical Safety Procedures | 10 | CO4 |
| 5. | Electronic Devices | 10 | CO5 |
| | Total | 60 | |

| | | | |
|---|---|---|---|
| **COURSE OBJECTIVES** | To familiarize the basic concepts of electrical principles and machines. | | |
| | To understand the construction and working of different measuring instruments and electronic devices and safety of electrical systems. | | |
| | To gain the knowledge to operate different electrical equipment and electronic devices. | | |

| | | | |
|---|---|---|---|
| **COURSE OUTCOMES** | CO1 | M303.1 | Explain the basic concepts of electrical principles and their applications. |
| | CO2 | M303.2 | Describe the usage of various electrical machines for different applications. |
| | CO3 | M303.3 | Illustrate various electrical measuring instruments and analyse the working of various measuring instruments. |
| | CO4 | M303.4 | Select appropriate safety instruments and procedures to prevent electrical hazards and analyze various causes of hazards |
| | CO5 | M303.5 | Describe the working of basic electronic devices. |

## MODEL BLUE PRINT for the Question Paper

| S.No | Chapter/ Unit Title | No. of periods | Weightage Allocated | Marks wise Distribution of Weightage | | | | Question wise Distribution of Weightage | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | R | U | Ap | An | R | U | Ap | An |
| 1 | Electrical Engineering Fundamentals | 14 | 14 | 3 | 3 | 8 | | 1 | 1 | 1 | |
| 2 | Electrical Machines | 16 | 14 | 3 | 3 | 8 | | 1 | 1 | 1 | |
| 3 | Electrical Measuring Instruments | 10 | 14 | 3 | 3 | 8 | 10 | 1 | 1 | 1 | 1 |
| 4 | Electrical Safety Procedures | 10 | 14 | 3 | 3 | 8 | | 1 | 1 | 1 | |
| 5 | Electronic Devices | 10 | 14 | 3 | 3 | 8 | | 1 | 1 | 1 | |
| | **Total** | **60** | **70+10** | **15** | **15** | **40** | **10** | **5** | **5** | **5** | **1** |

R-Remembering;    U-Understanding;    Ap-Applying;    An- Analylising
**Note: 10 Marks Higher Order question may be given from the chapter - 1, or 2 or 3 or 4 or 5.**

**LEARNING OUTCOMES**

## 1.0 Electrical Engineering Fundamentals

1.1 Define Ohm's Law and state the laws of resistance.

1.2 State work, power and energy.

1.3 State and explain Kirchhoff's laws.

1.4 Define the terms

    (a) Flux                  (b) Permeability         (c) Reluctance

    (d) Inductance        (e) Permittivity           (f) Capacitance.

1.5 State

    (a) Faradays laws of Electro Magnetic Induction
    (b) Lenz's law
    (c) Fleming's right hand rule
    (d) Fleming's left hand rule

1.6 State and explain dynamically induced EMF and statistically induced EMF.

1.7 State and explain Self-inductance, Mutual inductance and Coefficient of coupling.

1.8 Define the terms

    (a) Alternating Current    (b) Instantaneous Value    (c) Maximum Value
    (d) Time Period         (e) Frequency           (f) Average Value
    (g) R.M.S Value        (h) Form Factor         (i) Phase Difference
    (j) Power           (k) Power Factor

1.9 State power and power factor in

    (a) Pure resistor        (b) Pure inductor       (c) Pure capacitor

1.10 Explain single phase A.C. series circuits consisting of

    (a) R-L             (b) R-C                 (c) R-L-C.

1.11 Explain three phase system with voltage, current and power equations.

1.12 State the advantages of three phase system over single phase system.

## 2.0 Electrical Machines

2.1 Explain the construction and working of D.C. Generator.

2.2 List the type of D.C. Generators and draw the schematic diagram of each type.

2.3 Write the currents and voltages equations for different types of D.C. Generators.

2.4 Explain the working of Welding Generator with circuit diagram.

2.5 Explain the construction and working of D.C. Motor.

2.6 List the type of D.C. Motors and draw the schematic diagram of each type.

2.7 Write the currents and voltages equations for different types of D.C. Motors.

2.8 State the methods of speed control of D.C. Motors.

2.9 Explain the construction and working of Transformer.

2.10 Explain the working of Welding Transformer with circuit diagram.

2.11 Explain the construction and working of Three Phase Induction Motor.

2.12 Explain the construction and working of Single Phase Induction Motor.

2.13 List the types of Single Phase Induction Motors.

2.14 List the application of the following electrical motor

(a) DC Motor

(b) Three Phase Induction motor

(c) Single Phase Induction Motor

**3.0 Electrical Measuring Instruments**

3.1 List the types of electrical measuring instruments.

3.2 Explain the construction and working of Moving Coil Measuring Instrument.

3.3 Explain construction and working of Attraction Type Moving Iron Measuring Instrument.

3.4 Explain construction and working of Repulsion Type Moving Iron Measuring Instrument.

3.5 Compare Moving Coil Measuring Instrument and Moving Iron Measuring Instrument.

3.6 Explain the construction and working of Dynamometer Type Measuring Instrument.

3.7 Explain the construction and working of Induction Type Single Phase Energy meter.

**4.0 Electrical Safety Procedures.**

4.1 Explain the effects of electrical shock and burn.

4.2 Explain the procedures to be adopted to avoid electric shock.

4.3 Explain the first aid methods to be followed after electrocuted.

4.4 State the need of earthing of electrical equipment and machinery.

4.5 State the types of earthing of electrical equipment and machinery.

4.6 Explain the procedure of pipe earthing with diagram.

4.7 Explain the procedure of plate earthing with diagram.

**5.0 Electronic Devices**

5.1 Classify materials as conductor, semiconductors and insulators.

5.2 Distinguish between intrinsic and extrinsic semiconductors.

5.3 Explain the formation of P- type and N- type materials.

5.4 Explain the formation of PN Junction diode.

5.5 Explain the working of PN junction diode with forward bias and reverse bias.

5.6 Explain the formation of PNP and NPN transistors

5.7 Draw the circuit diagrams, input characteristics and output characteristics of transistor in Common Base, Common Emitter and Common Collector configurations.

5.8 Explain the working of Zener diode.

5.9 Explain the working of Light Emitting Diode.

## COURSE CONTENTS

### 1. Electrical Engineering Fundamentals

Ohm's Law - the laws of resistance - work, power and energy - Kirchhoff's laws – Flux – Permeability –Reluctance – Inductance – Permittivity - Capacitance. - Faradays laws of Electro Magnetic Induction - Lenz's law - Fleming's right hand rule - Fleming's left hand rule - dynamically induced EMF and statistically induced EMF - Self-inductance, Mutual inductance and Coefficient of coupling - Alternating Current - Instantaneous Value - Maximum - Time Period - Frequency – Average Value - R.M.S Value - Form Factor - Phase Difference – Power - Power Factor - power and power factor in Pure resistor, Pure inductor and Pure capacitor -single phase A.C. series circuits - three phase system with voltage, current and power equations - advantages of three phase system over single phase system.

### 2. Electrical Machines

Construction and working of D.C. Generator - type of D.C. Generators and the schematic diagram of each type - currents and voltages equations for different types of D.C. Generators - working of Welding Generator with circuit diagram - construction and working of D.C. Motor - type of D.C. Motors and schematic diagram of each type - the currents and voltages equations for different types of D.C. Motors - methods of speed control of D.C. Motors - construction and working of Transformer - working of Welding Transformer with circuit diagram - construction and working of Three Phase Induction Motor - construction and working of Single Phase Induction Motor - types of Single Phase Induction Motors - application of the DC Motor, Three Phase Induction motor, Single Phase Induction Motor.

### 3. Electrical Measuring Instruments

Types of electrical measuring instruments - construction and working of Moving Coil Measuring Instrument - construction and working of Attraction Type Moving Iron Measuring Instrument - construction and working of Repulsion Type Moving Iron Measuring Instrument - Compare Moving Coil Measuring Instrument and Moving Iron Measuring Instrument - construction and working of Dynamometer Type Measuring Instrument - construction and working of Induction Type Single Phase Energymeter.

### 4. Electrical Safety Procedures.

Effects of electrical shock and burn - procedures to be adopted to avoid electric shock - first aid methods to be followed after electrocuted - need of earthing of electrical equipment and machinery - types of earthing of electrical equipment and machinery - procedure of pipe earthing with diagram - procedure of plate earthing with diagram.

### 5. Electronic Devices

Classify materials as conductor, semiconductors and insulators - Distinguish between intrinsic and extrinsic semiconductors - formation of P- type and N- type materials -  formation of PN Junction diode - working of PN junction diode with forward bias and reverse bias - formation of PNP and NPN transistors - circuit diagrams, input characteristics and output characteristics of transistor inCommon Base, Common Emitter and Common Collector configurations - working of Zener diode - working of Light Emitting Diode.


**REFERENCE BOOKS**

1. A Text Book of Electrical Engineering and Electronics  -  BL Theraja
2. Principles of Electrical Engineering and Electronics  -  VK Mehta
3. Basic Electrical and Electronics Engineering  -  DP Kothari & IJ Nagrath
4. A Text Book of Electrical Engineering  -  JB Gupta
5. A Text Book of Electrical Engineering  -  BL Theraja & AK Theraja

# BASIC THERMODYNAMICS

| Course Title | Course Code | Periods/Week | Periods per Semester |
|---|---|---|---|
| Basic Thermodynamics | M-304 | 04 | 60 |

## TIME SCHEDULE

| S. No. | Chapter/Unit Title | Periods | Weightage of Marks | Short Answer Questions (3M) | Essay Type Questions (8M) | Higher Order Question (10M)) |
|---|---|---|---|---|---|---|
| 1 | Fundamentals of Thermodynamics | 12 | 14 | 02 | 1 | |
| 2 | Laws of Perfect Gases | 10 | 14 | 02 | 1 | |
| 3 | Thermodynamic Processes on Gases | 16 | 14 | 02 | 1 | 01 |
| 4 | Air Standard Cycles | 12 | 14 | 02 | 1 | |
| 5 | Calorific Values of Fuels | 10 | 14 | 02 | 1 | |
| | Total | 60 | 70+10 | 10 | 05 | 01 |

**Note: 10 Marks higher order question may be given from Chapter- 3 or Chapter - 4.**

## Course Objectives and Course Outcomes

| Course Objectives | | Upon completion of the course the student shall be able to: Analyse the Thermodynamic Processes ,Air Standard Cycles and Fuels for Combustion | |
|---|---|---|---|
| **Course contents** | | | Upon completion of the course the student shall be able to: |
| | CO1 | M-304.1 | Explain the basics and laws of thermodynamics and solve problems on thermodynamic laws |
| | CO2 | M-304.2 | Apply Gas Laws to solve problems in thermodynamics |
| | CO3 | M-304.3 | Solve the problems on Thermodynamic Processes. |
| | CO4 | M-304.4 | Discuss Air Standard Cycles in order to compare with the actual cycles used in various thermodynamic systems |
| | CO5 | M-304.5 | Explain different methods to determine the calorific values of fuels. |

**Model Blue Print of a Question Paper**

| Sl. No | Chapter Name | Periods Allocated | Weightage Allocated | Marks Wise Distribution of Weightage | | | | Question Wise Distribution of Weightage | | | | CO's Mapped |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | R | U | Ap | An | R | U | Ap | An | |
| 1 | Fundamentals of Thermodynamics | 12 | 14 | 03 | 03 | 08 | - | 01 | 1 | 01 | | CO1 |
| 2 | Laws of Perfect Gases | 10 | 14 | 03 | 03 | 08 | | 01 | 1 | 01 | | CO2 |
| 3 | Thermodynamic Processes on Gases | 16 | 24 | 03 | 03 | 08 | 10 | 01 | 1 | 01 | 01 | CO3 |
| 4 | Air Standard Cycles | 12 | 14 | 03 | 03 | 08 | | 01 | 1 | 01 | | CO4 |
| 5 | Calorific Values of Fuels. | 10 | 14 | 03 | 03 | 08 | | 01 | 1 | 01 | | CO5 |
| | TOTAL | 60 | 80 | 15 | 15 | 40 | 10 | 05 | 5 | 05 | 01 | |

R-Remembering;    U-Understanding;    Ap-Applying;    An- Analylising

**Note:  10 Marks higher order question may be given from the chapter-3 or Chapter - 4. (Here it is taken from the Chapter – 3)**

**Learning Outcomes**
Upon on completion of the course the student shall be able to:

**1.0    Fundamentals of Thermodynamics.**

1.1    Define the system, boundary, universe and working fluid of a thermodynamic system.
1.2    Explain the three types of thermodynamic systems with examples.
1.3    List the types of thermodynamic properties of a system.
1.4    Explain Extensive properties and Intensive properties with examples.
1.5    Define the terms heat, work, quasi-static work and flow work.
1.6    Define thermodynamic state, path, process and cycle with graphical representations.
1.7    Differentiate reversible and irreversible processes with examples.
1.8    State the conditions for reversibility of a process and thermodynamic cycle.
1.9    Define the Zeroth law of thermodynamics and Thermal equilibrium.
1.10    State first law of thermodynamics for a cycle, its significance, limitations and applications.
1.11    Write non-flow energy equation (NFEE) stating the units of the terms involved and Solve simple problems on non-flow energy equation applicable to closed systems.
1.12    Write steady flow energy equation   (SFEE) stating the units of the terms involved and Solve simple problems on steady flow energy equation only.

1.13     State Clausius and Kelvin-Planck statements of Second law of thermodynamics – Significance – Applications.

1.14    State the Concept of Entropy.

## 2.0     Laws of Perfect Gases.

2.1     State 1. Boyle's Law 2. Charle's Law 3. Avogadro's Law 4. Regnault's Law and 5. Joule's Law with graphical representations and writes mathematical expressions.

2.2     Define Perfect gas and derive the characteristic gas equation.

2.3     Write universal gas equation.

2.4     State relationship between characteristic gas constant (R), universal gas constant (G) and molecular weight (M).

2.5     Define Specific heat, specific heat at constant pressure ($C_p$) and specific heat at constant volume ($C_v$).

2.6     State the reason for $C_p$ is being more than $C_v$.

2.7     Derive the relationship connecting the two specific heats and characteristic gas constant (R).

2.8     Solve simple problems using gas laws and gas equations.

## 3.0     Thermodynamic Processes on gases.

3.1     List and define popular thermodynamic processes on gases.

3.2     Draw the Pressure- Volume diagrams for the isochoric, isobaric, isothermal, isentropic, and polytropic processes.

3.3     Draw Temperature - Entropy diagrams for the isochoric, isobaric, isothermal, isentropic, and polytropic processes.

3.4     Write the mathematical expressions for change in internal energy, work transfer, heat transfer, change in enthalpy and change in entropy for an Isochoric process.

3.5     Write the mathematical expressions for change in internal energy, work transfer, heat transfer, change in enthalpy and change in entropy for an Isobaric process.

3.6     Write the mathematical expressions for change in internal energy, work transfer, heat transfer, change in enthalpy and change in entropy for an Isothermal process.

3.7     Write the mathematical expressions for change in internal energy, work transfer, heat transfer, change in enthalpy and change in entropy for an isentropic process.

3.8     Write the mathematical expressions for change in internal energy, work transfer, heat transfer, change in enthalpy and change in entropy for a Polytropic process.

3.9     Solve simple problems on the isochoric, isobaric, isothermal, and isentropic and polytropic processes to calculate heat transfer, work transfer, change in internal energy, change in enthalpy and change in entropy.

3.10    Explain Hyperbolic process.
3.11    Explain Throttling process
3.12    Explain Free expansion of gases.


## 4.0    Air Standard Cycles

4.1    Define the term 'Air Standard cycle'.
4.2    List important air standard cycles and their practical applications.
4.3    State the assumptions made in analysis of 'Air Standard cycles'.
4.4    Define the term Air Standard efficiency.
4.5    Represent Carnot cycle on p-V and T-s diagrams.
4.6    State the assumptions made in the analysis of Carnot cycle.
4.7    Derive an expression for the air standard efficiency of a Carnot cycle with the help of p-V and T-s diagrams– Simple Problems.
4.8    Represent Otto Cycle on p-V and T-s diagrams.
4.9    State the assumptions made in analysis of Otto Cycle.
4.10    Derive an expression for the air standard efficiency of a Otto Cycle with the help of p-V and T-s diagrams – Simple Problems.
4.11    State the assumptions made in analysis of Diesel cycle.
4.12    Derive an expression for the air standard efficiency of a Diesel cycle with the help of p-V and T-s diagrams– Simple Problems.


## 5.0 Calorific Values of Fuels
5.1    Define the terms fuel and combustion.
5.2    Classify fuels with examples.
5.3    State the advantages, disadvantages and applications of commonly used solid fuels.
5.4    State the advantages, disadvantages and applications of commonly used liquid fuels.
5.5    State the advantages, disadvantages and applications of commonly used gaseous fuels.
5.6    Compare solid, liquid and gaseous fuels.
5.7    Define the term calorific value of a fuel and types of calorific values.
5.8    Define Higher Calorific and Lower Calorific Values of fuel with units.
5.9    Write the Dulong's formula for calculating the higher calorific value of a fuel and then lower calorific value of the fuel – simple problems.
5.10    Explain the need of proximate and ultimate analysis of fuels.
5.11    Describe the unit and summarize the procedure for the determination of calorific value of the Solid and Liquid fuels with Bomb calorimeter – Simple Problems
5.12    Describe the unit and summarize the procedure for the determination of calorific value of the gaseous fuel with Junker's gas calorimeter – Simple Problems

**COURSE CONTENT**

**1.0    Fundamentals of Thermodynamics.**

Definition for system, boundary, surroundings, Universe, Working fluid of a system;

Types of thermodynamic systems: closed, open and isolated systems with examples;

Properties of thermodynamic system: Intensive and Extensive properties with examples;

Definitions of various properties of system like Pressure, Volume, Specific volume, Density, Specific weight, Specific gravity, Temperature , Enthalpy, Internal energy and their units with mathematical expressions .

Definitions for thermodynamic state, path, process and cycle with graphical representations; Reversible and irreversible processes – Examples – Conditions for reversibility of a process and cycle;

Definitions for heat, work, quasi-static work and flow work - Simple problems on quasi-static work (pdv work)

Statements of Zeroth, First and Second laws of thermodynamics - Significances- PMM1- PMM2- Limitations – State the Applications.

Non flow energy equation **(without proof)** - simple problems on NFEE.

Steady flow energy equation **(without proof)** - simple problems on SFEE only

Definitions of heat engine, heat pump and refrigerating machine.   **(No Problems)**

Concept of Entropy – Write the Mathematical Expression for Entropy- Significance.

**2.0    Laws of Perfect Gases.**

Define Perfect gas - Brief explanation of various perfect Gas Laws - Boyle's law, Charle's Law, Avogadro's Joule's law and Regnault's law- Graphical representations – Mathematical expressions for all the above laws -  Simple problems on gas laws.

Derive characteristic gas equation $pV = mRT$;

Write universal gas equation and state the relationship of Universal gas constant with gas constant and molecular weight of the gas;

Definition of Specific heat of a gas - Specific heat at constant pressure and Specific heat at constant volume for a gas – Change in internal energy – Change in enthalpy – Mathematical expressions for change in internal energy and change in enthalpy of a gas -  simple problems.

Derive an expression showing the relationship between the two specific heats and characteristic gas constant;

Simple problems on Characteristic and Universal gas equations;

**3.0    Thermodynamic Processes on Gases.**

Introduction to popular thermodynamic processes on gases - Isochoric, Isobaric, Isothermal, Hyperbolic, Isentropic, Polytropic and Throttling processes ;

Representation of the thermodynamic processes on Pressure- volume and Temperature – entropy diagrams;

Write the mathematical expressions for change in internal energy, work transfer, heat transfer, change in enthalpy and change in entropy for

Isochoric, Isobaric, Isothermal, Isentropic, and Polytropic processes.
**(Without Proofs);**
Solve simple problems on the isochoric, isobaric, isothermal, and isentropic and polytropic processes to calculate heat transfer, work transfer, change in internal energy, change in enthalpy and change in entropy.

**4.0   Air Standard Cycles.**

Meaning of air standard cycle- Introduction to important air standard cycles;
Assumption made in the analysis of various air standard cycles– Air standard Efficiency;
Derivation of Carnot cycle efficiency with p-V and T-s diagrams -Problems on Carnot cycle;  Derivation of Otto cycle Efficiency with p-V and T-s diagrams - Simple problems on Otto cycle; Derivation of Diesel cycle efficiency with p-V and T-s diagrams - Simple problems on Diesel cycle;
Reasons for the highest efficiency of Carnot cycle over other air standard cycles working between same temperature limits.

**5.0   Calorific Values of Fuels.**

Definition of fuel and combustion;
Characteristics of fuels;
Types of fuels - solid, liquid and gaseous fuels – Examples;
Advantages, disadvantages, applications of different types of fuels.
Calorific value (Higher and lower) of fuels, Dulong's formula for calculating calorific values - Simple problems;
Need of proximate and ultimate analysis of fuels.
Bomb calorimeter: Unit-description-procedure and write mathematical expression for calculating Calorific values of solid or liquid fuel using Bomb calorimeters – Simple Problems.
Junker's Gas calorimeter: Unit – description – Procedure and write mathematical expression for calculating calorific value of gaseous fuel using Junker's calorimeter– Simple problems;

## REFERENCE BOOKS

1.  P. K. Nag, Engineering Thermodynamics, 2017, McGraw Hill Education
     Publishers
2.  C. P. Arora, Thermodynamics, 2004, McGraw Hill Education Publishers
3.   Thermal Engineering -  J.K.Guptha  and R. S. Khurmi, 2015, S.Chand &
     Company

# STRENGTH OF MATERIALS

| Course Title | Course Code | Periods/Week | Periods per Semester |
|---|---|---|---|
| Strength of Materials | M-305 | 04 | 60 |

## TIME SCHEDULE

| S. No. | Chapter/Unit Title | Periods | Weightage of Marks | Short Answer Questions (3M) | Essay Type Questions (8M) | Higher Order Question (10M) |
|---|---|---|---|---|---|---|
| 1 | Simple Stresses and Strains | 20 | 17 | 3 | 1 | * |
| 2 | Strain energy | 09 | 09 | 3 | - | |
| 3 | Shear Force and Bending Moment | 15 | 19 | 1 | 2 | |
| 4 | Theory of Simple Bending & Deflection of Beams | 10 | 14 | 2 | 1 | * |
| 5 | Torsion in Shafts | 06 | 11 | 1 | 1 | |
| | **Total** | **60** | **70+10** | **10** | **5** | **1** |

**Note:** *10 marks higher order question may be given from either from Chapter 1 or Chapter 4.**

## Course Objectives and Course Outcomes

| | | | |
|---|---|---|---|
| **Course Objectives** | | | Upon the completion of course the student shall be able to understand the concepts of stress and strain and to find them in structural members viz., bars, beams, shafts for given conditions. |
| **Course Outcomes** | CO1 | M-305.1 | Explain the concept of stress and strain and various constituent relations |
| | CO2 | M-305.2 | Calculate the resilience in the bars |
| | C03 | M-305.3 | Calculate and draw the shear force and bending moment for the Cantilever and Simply Supported Beams subjected to point loads and UDL. |
| | CO4 | M-305.4 | Calculate the Flexural stresses in Cantilever and Simply Supported Beams of various cross-sections |
| | CO5 | M-305.5 | Derive the expression for Torsional Stresses in circular shafts and find them in solid and hallow circular shafts |

**Model Blue Print of the Question Paper**

| S. No | Chapter Name | Periods Allocated | Weightage Allocated | Marks Wise Distribution of Weightage | | | | Question Wise Distribution of Weightage | | | | CO's Mapped |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | R | U | Ap | An | R | U | Ap | An | |
| 1 | Simple Stresses and Strains | 20 | 27 | 9 | | 8 | 10 | 3 | | 1 | 1 | CO1 |
| 2 | Strain energy | 09 | 09 | 9 | - | - | - | 1 | 2 | - | - | CO2 |
| 3 | Shear Force and Bending moment | 15 | 19 | 3 | | 16 | - | 1 | | 2 | - | CO3 |
| 4 | Theory of Simple bending & Deflection of Beams | 10 | 14 | 3 | 03 | 8 | - | 1 | 1 | 1 | - | CO1, CO4 |
| 5 | Torsion in Shafts | 06 | 11 | - | 03 | 8 | - | - | 1 | 1 | - | CO1, CO5 |
| | TOTAL | 60 | 80 | 24 | 06 | 40 | 10 | 06 | 4 | 05 | 01 | |

 **Note** [*] **10 marks higher order question may be given from either Chapter 1 or Chapter 4. (Here it is taken from chapter -1)**

**LEARNING OUTCOMES:**
Upon the completion of course the student shall be able to

**1.0 Simple Stresses and Strains**
1.1  Classify the forces on different criteria
1.2  Differentiate the rigid body from the deformable body
1.3  Explain the concept of stress and strain
1.4  Draw the stress – strain diagrams for ductile and brittle materials subjected to tensile forces.
1.5  Define elastic constants and Poisons ratio.
1.6  Write expressions relating the elastic constants and Poisons ratio.
1.7  Calculate the stresses and strains in bars of uniform and varying cross – section subjected to end forces and intermediate forces.
1.8  Calculate the stresses and strains in composite bars.
1.9  Calculate the thermal stresses in uniform and composite Bars
1.10  Numerical problems related to the above cases.

**2.0 Strain Energy**
2.1  Understand the concept of strain energy and define the terms related to it
2.2  Derive the expressions for the stresses developed in bars subjected to Gradual, Sudden and Impact loads.

2.3    Calculate the stresses and strains in the bars using the strain energy concepts.

**3.0 Shear Force and Bending Moment**

3.1    State the concept of beams

3.2    Classify beams based on supports.

3.3    Define the shear force and bending moment in beams

3.4    Calculate the Shear Force and Bending Moment in Cantilever, Simply Supported subjected to Concentrated, UDL and combined loads. Draw their variation along the length of the beams.

3.5    Numerical problems related to the above cases.

**4.0 Theory of Simple Bending and Deflection of Beams**

4.1    Define a) Neutral layer, b) Neutral Axis, c) Radius of curvature d) Moment of Resistance, e) Bending stress f) Moment of Inertia g) Section Modulus  f) Flexural Rigidity

4.2    Derive the expression for the Bending Moment (Flexural Formula ) by stating the assumptions.

4.3    Calculate the bending stresses in beams of various cross-sections.

4.4    Define the slope and deflection of beam

4.5    Write the expressions for slope and deflection in cantilever and simply supported beams for standard cases.

4.3    Numerical problems related to the above cases.

**5.0 Torsion in Shafts**

5.1    Derive the expression for the Torsional equation by stating the assumptions.

5.2    Calculate the stresses developed in the solid and hallow circular shafts

5.3    Calculate the dimensions of the solid and hallow circular shafts subjected to torsion and also check them for rigidity.

5.4    Compare the strength and weight of the solid and hallow shafts for the given conditions.

5.5    Numerical problems related to the above cases.

**COURSE CONTENTS:**

**1        Simple Stresses and Strains**

Classification of Loads and their effects - Difference between rigid body and deformable body - Concept of stress and strain - Hooke's law - - Stress-strain diagrams for ductile and brittle materials - elastic constants – Poisons ratio  - Factor of safety - Relation between elastic constants Stresses and strains in the bars - Stresses and strains in uniform bars and varying cross-section subjected to end point loads and intermediate loads - Stresses and strains in the

composite bars - Thermal stresses in uniform and composite bars - Related numerical problems on the above cases.

## 2 Strain Energy

Strain energy or resilience, proof resilience and modulus of resilience - Strain energy in the bars of uniform cross-sections - Derivation of expression for the stress in the bars of uniform cross-section using strain energy concept for the following cases - i) Gradually applied load, ii) Suddenly applied load, iii) Impact/shock load - Related numerical problems on the above cases.

## 3 Shear Force & Bending Moment Diagrams

Classification of beams based on supports - Types of Loads – Concentrated load, UDL and UVL - Definition and explanation of shear force and bending moment - Calculation of shear force and bending moment at any point along the length of the beam and drawing the diagrams by the analytical method only for the following cases - a) Cantilever with concentrated and uniformly distributed loads, b) Simply supported beam with concentrated and uniformly distributed loads, - Finding the location of points of contraflexure.

## 4 Theory of Simple Bending and Deflection of Beams

Explanation of the terms - a) Neutral layer, b) Neutral Axis, c) Radius of curvature d) Moment of Resistance, e) Bending stress f) Moment of Inertia g) Section Modulus  f) Flexural Rigidity - Assumptions in theory of simple bending- Derivation of Bending / Flexural Equation $M / I = \sigma / Y = E / R$ - Problems on calculating the bending stress, dimensions of the cross-section of beam, safe load and radius of curvature - Definition of slope and deflection of beams - Deflection formulae without proof for cantilever and simply supported beams with point load and uniformly distributed load only (Standard cases only)

## 5 Torsion in Shafts

Definition and functions of shaft - Calculation of polar moment of inertia and polar section modulus for solid and hollow shafts - Assumptions in simple torsion - Derivation of torsional formula $T / J = \tau / R = G\theta / L$ - Problems on design of shaft based on strength and rigidity -   Numerical Problems related to comparison of strength and weight of solid and hollow shafts.

## REFERENCE BOOKS:

1.    Strength of Materials      by    B.C.Punmia
2.    Strength of Materials      by    R.S. Khurmi  S & Chand Company
3.    Mechanics of Materials      by    Gere McGH

# PRODUCTION TECHNOLOGY - I

| Course Title | Course Code | Periods per Week | Periods per Semester |
|---|---|---|---|
| Production Technology - I | M–306 | 04 | 60 |

## TIME SCHEDULE

| S. No. | Chapter/Unit Title | Periods | Weightage of Marks | Short Answer Questions (3M) | Essay Type Questions (8M) | Higher Order Question (10M) |
|---|---|---|---|---|---|---|
| 1 | Lathe & Lathe Work | 18 | 17 | 03 | 01 | |
| 2 | Shaper, Slotter, Planner | 14 | 17 | 03 | 01 | 01 |
| 3 | Broaching Machine | 06 | 08 | - | 01 | |
| 4 | Cutting Fluids, Coolants and Lubricants | 06 | 06 | 02 | - | - |
| 5 | Welding | 16 | 22 | 02 | 02 | |
| | Total | 60 | 70+10 | 10 | 05 | 01 |

**Note: 10 Marks higher order question may be given from Chapter - 1 or Chapter - 2.**

**Course Objectives and Course Outcomes**

| Upon completion of the course the student shall be able to | | | |
|---|---|---|---|
| **COURSE OBJECTIVES** | | 01 | Describe the construction details and various operations on Lathe Machines, Shaper, Slotter, Planer |
| | | 02 | Describe the construction details and various operations on Broaching machine<br>Describe the various welding operations |
| **COURSE OUT COMES** | CO1 | M306-1 | Describe various operations on 1.Lathe Machine, 2.Shaper, 3.Slotter and 4.Planer |
| | C02 | M306-2 | Describe various operations on Broaching Machine |
| | C03 | M306-3 | Discuss the appropriate cutting fluids, coolants and Lubricants depending upon the application. |
| | C04 | M306-4 | Explain the working principle of various welding processes. |
| | C05 | M306-5 | Describe the welding operations that are used in different welding processes. |

**Blue Print of Question Paper**

| S. No | Chapter/ Unit Title | Periods Allocated | Weightage Allocated | Marks Wise Distribution of Weightage | | | | Question Wise Distribution of Weightage | | | | CO's Mapped |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | R | U | Ap | An | R | U | Ap | An | |
| 1 | Lathe & Lathe Work | 18 | 27 | 06 | 03 | 08 | 10 | 02 | 01 | 1 | 01 | CO1 |
| 2 | Shaper, Slotter, Planner | 14 | 17 | 06 | 03 | 08 | | 02 | 01 | 01 | | CO1 |
| 3 | Broaching Machine | 06 | 08 | | | 08 | | | | 01 | | CO2 |
| 4 | Cutting Fluids, Coolants and Lubricants. | 06 | 06 | 03 | 03 | | | 01 | 01 | | | CO3 |
| 5 | Welding | 16 | 22 | 03 | 03 | 16 | | 01 | 01 | 02 | | CO4,C05 |
| | **TOTAL** | **60** | **80** | **18** | **12** | **40** | **10** | **06** | **04** | **05** | **01** | |

R-Remembering;    U-Understanding;    Ap-Applying;    An- Analylising

**Note:  10 Marks higher order question may be given from the Chapter - 1 or Chapter -2 (Here it is taken from the Chapter  – 1).**

**Learning Objectives:**
Upon completion of the course the student shall be able to

**1.0. Lathe and Lathe Work**

1.1.    State a)The working principle of lathe machine
b) The specifications of lathe machine
1.2.    List a) The six types of lathe machines b) List any three work holding devices
1.3.    Describe the working of Lathe with legible sketch
1.4.    Explain **a)** The procedure for Turning, Facing , taper turning, thread cutting, knurling, forming, drilling, boring, reaming, key way cutting operations on Lathe machine.
**b)** The methods of taper turning on lathe machine
1.5.    Calculate included angle for taper turning
1.6.    Describe the nomenclature of single point cutting tool with the help of legible sketch.
1.7.    State the significance of various angles

## 2.0. Shaping, Slotting, and Planning

2.1. Describe a) The construction and working principle of shaper with legible sketch b) The construction and working principle of slotter with legible sketch c) The construction and working principle of planer with legible sketch

2.2. List the operations performed on shaper, slotter, and planer.

2.3. State a) the specifications of shaper.
   b) The specifications of slotter.
   c) The specifications of planer.

2.4. Explain a) The principle of quick-return mechanism as applied to shaper and Planer b) Crank & slotted lever mechanism for obtaining the quick-return motion. c) Whit worth mechanism for obtaining the quick-return motion.

## 3.0. Broaching Machines

3.1. Define Broaching

3.2. Mention horizontal type (single ram& duplex ram) vertical type, pull up, pull down, and push down Broaching machines

3.3. Explain a) The working principle of vertical type Broaching machine with the help of neat Sketch
   b) The working principle pull up, pull down, and push down Broaching machines with the help of neat sketch

3.4. List Elements of broach tool

3.5. Explain nomenclature of broach teeth

3.6. List three types of broach teeth

3.7. Mention three different materials used for broach tool

3.8. State the advantages & limitations of broaching

## 4.0. Cutting Fluids, Coolants & Lubricants

4.1. State the properties of cutting fluids and coolants.

4.2. List any three types of cutting fluids

4.3. State the composition of cutting fluids and coolants

4.4. List three relative merits of the cutting fluids and coolants.

4.5. Select the proper cutting fluids and coolants for various machining operations.

4.6. List the solid, liquid and Gaseous lubricants

4.7. List any six properties of lubricants.

4.8. List any six applications of Lubricants.

## 5.0. Welding

5.1. State a) the necessity of welding
   b) The advantages and limitations of welding.
   c) The principle of flame cutting.
   d) The relative advantages of flame cutting over other types of cutting.

5.2. List six welding processes.

5.3. Explain a) the principle of arc welding.

b) The principle of gas welding.

c) The principles of soldering & brazing.

d) Non-destructive testing of welds.

e) The principle of TIG and MIG welding.

f) Different welding procedures in arc and gas welding.

5.4. List a) The tools and equipment of arc welding.

b) The tools and equipment of oxy-acetylene welding.

5.5. Identify a) proper electrodes used for given metals

b) correct soldering materials for a given job

5.6. Define the terms soldering & brazing.

5.7. Differentiate soldering from brazing.

5.8. List a) The gas cutting equipment.

b) Six various defects in welds.

c) Three reasons for welding defects

d) Modern welding techniques Submerged, $CO_2$, Atomic – Hydrogen, ultrasonic welding

## COURSE CONTENT

### 1.0 Lathe and Lathe Work

Working Principle of Lathe - types of Lathes - Engine lathe – construction details and specifications. Nomenclature of single point cutting tool, geometry, tool signature, functions of tool angles. General and special operations – (Turning, facing, taper turning thread cutting, knurling, forming, drilling, boring, reaming, key way cutting.) Methods of taper turning – explanation. Lathe accessories viz., work holding devices and tool holding devices.

### 2.0 Shaping, Slotting, and Planning

Introduction to shaper, slotter, planer. Constructional details and specifications of shaper, slotter and planer. Operations on these machines. Tools and materials. Driving mechanisms- quick return arrangement - crank & slotted lever mechanism, whit worth mechanism.

### 3.0 Broaching Machines

Introduction to broaching. Types of broaching machines – horizontal type (single ram & duplex ram) vertical type, pull up, pull down, and push down. Elements of broach tool, broach teeth details – nomenclature –types – tool material.

### 4.0 Cutting Fluids, Coolants & Lubricants

Introduction to coolants and lubricants. Types of cutting fluids. Properties and functions of fluids and coolants. Fluids and coolants required in turning, drilling, shaping, sawing & Broaching. Selection of cutting fluids, methods of application of cutting fluid. Classification of lubricants (solid, liquid, gaseous) Properties and applications of lubricants.

## 5.0   Welding

Introduction Classification of welding processes. Advantages and limitations of welding.  Principles of arc welding. Arc welding equipment. Choice of electrodes for different metals. Principle of gas (oxy – acetylene) welding. Equipment of gas welding. Welding procedures (arc& gas) Soldering and Brazing techniques. Types and applications of solders & fluxes. Various flame cutting processes. Advantages and limitations of flame cutting. Defects in welding. Testing and inspection. Modern welding methods, (Submerged, $CO_2$, Atomic – Hydrogen, ultrasonic welding), Brief description of MIG & TIG Welding.

## REFERENCE BOOKS

1.      Welding Technology        by   Richard L Little (Tata McGraw Hill)
2.      Elements of Work Shop Technology vol. I & II   by   Hazra   Choudry   (Media Promoters and Publishers Pvt. Ltd.)
3.      Engineering Metrology      by R K Jain (Khanna Publications)
4.      Welding Technology         by R S Parmar (Khanna Publications)
5.      Manufacturing Technology (volume-1)    by P N Rao (Tata McGraw Hill)

# MACHINE DRAWING

| Course Title | Course Code | Periods/ Week | Periods/Semester |
|---|---|---|---|
| Machine Drawing | M-307 | 06 | 90 |

## TIME SCHEDULE

| Sl.No | Chapter/Unit Title | Periods | Weightage of Marks | Short answer Questions | Essay type Questions |
|---|---|---|---|---|---|
| 1 | Introduction | 06 | - | - | - |
| 2 | Fastening Devices | 24 | 10 | 02 | - |
| 3 | Assembly Drawings | 48 | 40 | - | 02 |
| 4 | Piping Layouts and Joints | 6 | 05 | 01 | - |
| 5 | Welding Fabrication Drawings | 6 | 05 | 01 | - |
| | **Total** | **90** | **60** | **04** | **02** |

**Note:- In the end examination, candidate has to answer all questions in Part- A and one question out of two in Part-B**

I.S/B.S latest specification should invariably be followed in all topics.

## Course Objectives and Course Outcomes

| COURSE OBJECTIVES | On successful completion of the course, the students will be able to: |
|---|---|
| | 1. Familiarize Conventional symbols of mechanical components, Conventional methods of representing threaded fasteners and Riveted joints.<br>2. Know clear visualization of objects and the proficiency in reading and interpreting assembly drawings<br>3. Use reinforcing and enhancing the knowledge and skill acquired in assembly drawings. |
| COURSE OUTCOMES | On successful completion of the course, the students will be able to: |
| | CO1 | M 307.1 | Use Conventional symbols as per IS code SP46. |
| | CO2 | M 307.2 | Use the Conventional methods of representing fasteners and joints |
| | CO3 | M 307.3 | Prepare the construction piping layouts and joints |
| | CO4 | M 307.4 | Draw the welded fabrication drawings |
| | CO5 | M 307.5 | Draw the assembly drawing of a machine component for the given details |

**Blue Print of Question Paper**

| S.No | Chapter name | Periods allocated | Weightage allocated | Mark wise distribution of weightage | | | |
|------|--------------|-------------------|---------------------|:---:|:---:|:---:|:---:|
| | | | | R | U | Ap | An |
| 1 | Introduction | 06 | | | | | - |
| 2 | Fastening Devices | 24 | 10 | 5 | 5 | | - |
| 3 | Assembly Drawings | 48 | 40 | | | 40 | - |
| 4 | Piping Layouts and Joints | 6 | 05 | 5 | | | - |
| 5 | Welding Fabrication Drawings | 6 | 05 | 5 | | | |
| | **TOTAL** | **15** | **60** | **15** | **5** | **40** | |

**Learning Outcomes**

Upon completion of the course the student shall be able to

**1.0 Understand the importance of machine drawing**
    1.1. Know the importance of Machine drawing.
    1.2. Review of 1$^{st}$ angle and 3$^{rd}$ angle Projections
    1.3. Review of Orthographic Projections and Sectional Views.

**2.0 Know about fastening devices**
    2.1. Draw the standard thread profiles.
    2.2. Draw bolted connections to standard proportions.
    2.3. Draw different types of screws.
    2.4. Draw different types of rivets and riveted connections.
    2.5. Draw different types of keys and cotters.

**3.0 Understand the assembly drawing practice and procedure**
    3.1. List the sequence of steps for preparing assembly drawing.
    3.2. Practice the assembly drawing for the given components drawing.
    3.3. Prepare the list of parts.

**4.0 Understand the piping layouts and joints.**
    4.1. State the distinction between pipes and tubes.
    4.2. Identify the common components of a piping layout.
    4.3. Identify the conventional symbols used for the various components of piping layout.
    4.4. Prepare single line and double line diagrams of piping layouts.
    4.5. Explain the use of packing material in joint.

**5.0 Appreciate the welded fabrication drawing.**
    5.1. Identify the different types of welds and their symbolic representation as per B.I.S., SP-46-2003
    5.2. Identify the elements of welding symbol and their standard location on the symbol.
    5.3. State welding process to be used, surface contour and finish of weld when given in symbolic form.
    5.4. Practice the Preparation of working drawing of welded fabrications.

**COURSE CONTENT**

**1.0 Introduction**
    1.1. Importance of Machine Drawing.
    1.2. Brief revision of 1$^{st}$ and 3$^{rd}$ angle projections
    1.3. Understand the concepts of Orthographic projections and Sectional views.

**2.0 Fastening Devices**
    2.1. Temporary and Permanent fastenings and their areas of application-thread nomenclature, forms of screw thread profiles, Metric, B.A., Acme, Knuckle, etc.
    2.2. Bolts and Nuts: Specification of bolts and nuts, Different types of bolted joints (like using through bolts, studs, screws etc.,) in different applications. Purpose of lock nuts and their Types.
    2.3. Keys and cotters: Types of keys and cotters: Difference between key and cotter -uses.
    2.4. Rivets and Riveted joints: Types, proportions and specification of rivets: Different types of riveted joints: Lap, Butt-single row, double row etc., chain and zigzag riveting – calculation of diameter of rivet: Pitch and arrangement of rivets in row – use of standard proportions.

**Drawing Plate: 1**
1. Exercise on Orthographic projections and Sectional views.
2. Thread Nomenclature and forms of screw thread profiles.
3. Exercises in drawing – bolted connections using standard proportions.
4. Drawing of various types of lock nuts & types of keys indicating their proportionate dimensions.
5. Exercise in drawing riveted joints using standard proportions: Single row, Double row (chain and zigzag) in lap and butt joints (single & double strap).

**3.0 Assembly Drawings**
    3.1. Need and functions of assembly and detailed drawings.
    3.2. Steps in preparing assembly drawings.
    3.3. Bill of materials and parts list.
    3.4. Exercises in preparing assembly drawings of commonly available engineering components.
    3.5. **Drawing Plate: 2**

**Draw the views / sectional views of**

| Socket and spigot joint | Sleeve and cotter joint | Stuffing box |
|---|---|---|
| Knuckle Joint assembly | Bush Pin type flanged coupling | Muff coupling (solid & split) |
| Universal coupling | Foot step bearing | Plummer block |
| Eccentric | Lathe tool post | Lathe tail stock |
| Cross Head | Gib & Cotter Joint | Screw Jack |

## 4.0 Piping layouts
4.1. Classification of pipes and tubes.
4.2. Components of pipes lay-out.
4.3. Screw fitting bend, elbow, tee, lateral Cross-nipple, reducing socket and plug.
4.4. Unions: Screwed ground and flanged.
4.5. Valves: Gate valve: angle valve, check valve.
4.6. Various conventional symbol used for the above components.

**Drawing Plate: 3**
1. Single line diagram of pipe layout, two exercises.
2. Double line diagram of pipe layout, one exercise.

## 5.0 Welded fabrication drawings
5.1. Different types of weld and their basic symbols including sectional representation as per table of I.S. standards, fillet, square butt, single V-Butt, double V-Butt, single bevel butt, double bevel butt, stud, bead (edge or seal), spot, seam.
5.2. Elements of welding symbol and their standard location, the symbol as per IS standards reference Code, arrow head, weld symbol, supplementary symbol, dimensions of welds, method of welding process, special reference.
5.3. Significance of arrow & position of arrow head significance of reference line as per I.S. standards with reference to fillet, V-Butt and stud welds.
5.4. Supplementary symbols and special instructions: Surface of reference line; as per I.S. standards with reference to fillet, V-Butt and stud welds.
5.5. Dimensions of welds: length, location and spacing of welds as per IS: 813-1991 standards with showing dimensions required on a welding.
5.6. Need of special reference

**Drawing Plate: 4**
1. Drawing tables and figs. Referred in the contents above taking form I.S. standards.
2. Dimensioning a given welding drawings as per I.S., SP-46-2003.
3. Preparing working drawing of welding fabrication from given data.

### REFERENCE BOOKS

1. Machine Drawing by **A.C. Parkinson**.
2. Machine Drawing by **Jones & Jones.**
3. Machine Drawing by **N.D. Bhat**.
**4.** Machine Drawing by **R.B. Gupta.**
5. Engineering drawing practice for schools & colleges: **SP-46-2003**.
6. Machine Drawing by **Bhattacharya** (Oxford Publishers).
7. Machine Drawing by **Ajeeth Singh** (MGH Publishers)
8. Machine Drawing by **N.Siddeswar, Kannaih, Sastri**. (MGH Publishers)

# MATERIAL TESTING & METALLOGRAPHIC LAB PRACTICE

| Course Title | Course Code | Periods/Week | Periods/Semester |
|---|---|---|---|
| Material Testing & Metallographic Lab Practice | M-308 | 03 | 45 |

## TIME SCHEDULE

| S.NO | EXERCISE TITLE | NO.OF PERIODS |
|---|---|---|
| 1 | Simple Tension Test | 09 |
| 2 | Compression Test | 03 |
| 3 | Impact Test (Charpy & Izod) | 06 |
| 5 | Hardness Test (Brinell & Rockwell Tests) | 06 |
| 6 | Flexural Test on Simply Supported & Cantilever Beams | 06 |
| 7 | Compression Test on Helical Spring | 03 |
| 8 | Study of Micro Structure of Ferrous and Non-ferrous Metals | 12 |
| | TOTAL | 45 |

## Course Objectives and Course Outcomes

| COURSE OBJECTIVE | | | Upon the completion of the course the student shall be able to conduct tests on various equipments to find the mechanical properties of the metals and operate the metallurgical microscope to see and draw the microstructure of metals |
|---|---|---|---|
| COURSE OUTCOMES | CO1 | M-308.1 | Operate the UTM to conduct various tests like i) Tension test ii) Compression Test iii) Shear test iv) Deflection Test on Spring to get basic mechanical properties of metals |
| | CO2 | M-308.2 | Conduct the Hardness tests and Impact tests to find Hardness and Impact Strength of given metals |
| | CO3 | M-308.3 | Perform Flexural Test on Simply Supported & Cantilever Beams to determine the Young's Modulus and Stiffness of the beam material |
| | CO4 | M-308.4 | Analyse the microstructure of a given metal |
| | CO5 | M-308.5 | Demonstrate ethics & etiquette while working in a group and display professionalism while communicating as a member and leader in a group |

**Learning Outcomes**
Upon completion of the course the student shall be able to

**1.0    Understand the various material testing methods.**
1.1    Conduct the simple tension test to find the various mechanical properties of the given material such as: yield stress, ultimate stress, percentage of elongation, percentage of reduction in area and Young's Modulus.
1.2    Conduct experiments on concrete cube, cast iron, timber to test for its compressive strength.
1.3    Practice the method of determining the Young's modulus of materials by the principle of deflection.
1.4    Determine the modulus of rigidity by the method of deflection of helical springs.
1.5    Conduct the hardness test to find the hardness of given material.
1.6    Perform the impact tests to find the impact strength of given metal
1.7    Practice the method of preparing a specimen for the metallography.
1.8    Interpret the microstructure of specified ferrous and nonferrous materials.
1.9    Handle the metallurgical microscope to study the microstructures.

**Key competencies to be achieved by the student**

| Exercise | Key competencies expected | Max. Marks | Marks awarded |
|---|---|---|---|
| Simple Tension Test | A. Fix the specimen in the jaws of the machine | 02 | |
| | B. Fix the strain gauge to the specimen | 02 | |
| | C. Apply the load gradually on the specimen | 02 | |
| | D. Record the  load, elongation without error | 01 | |
| | E. Plot the graph stress vs strain | 01 | |
| | F. Locate the points - elastic limit, yield stress, ultimate stress on the graph | 02 | |
| | **Total** | **10** | |
| Compression test | A. Place the specimen in the machine properly | 02 | |
| | B. Apply the load on the specimen gradually | 02 | |
| | C. Record the ultimate load | 01 | |
| | Total | 05 | |
| Shear Test | A. Place the specimen in the correct set of bushes in the shear shackles | 02 | |
| | B. Apply the load on the specimen gradually | 02 | |
| | C. Record the ultimate load | 01 | |
| | **Total** | **05** | |

| | | | |
|---|---|---|---|
| Impact test | A. Prepare the specimen as per the specifications | 05 | |
| | B. Fix the specimen on the machine appropriately | 02 | |
| | C. Release the load to hit the specimen cautiously | 02 | |
| | D. Record the energy absorbed by the specimen and find the impact strength | 01 | |
| | **Total** | **10** | |
| Hardness test | A. Place the specimen on the anvil of the specimen and fix the indenter | 01 | |
| | B. Place the loads on the load pan corresponding to the material of the specimen and size of indenter | 01 | |
| | C. Make the indent on the specimen properly | 02 | |
| | D. Measure the diameter of indentation with Brinell microscope | 03 | |
| | E. Calculate hardness number | 03 | |
| | **Total** | **10** | |
| Flexural Test on Beams | A. Measure the cross-sectional dimensions of the beam with vernier | 02 | |
| | B. Place the weight pans/hangers at the required positions | 01 | |
| | C. Fix the dial indicator at the correct location | 02 | |
| | D. Apply the loads gradually (in ascending and descending order) | 01 | |
| | E. Note the dial indicator readings(deflections) without parallax error | 02 | |
| | F. Plot the graph between load and deflection | 01 | |
| | G. Find the Stiffness and Young's Modulus of the beam material | 02 | |
| | **Total** | **10** | |
| Torsion test of springs | A.Measure spring diameter and spring wire diameter with vernier callipers | 04 | |
| | B.Measure deflection applying load | 02 | |
| | C. Calculate modulus of rigidity of spring material | 04 | |
| | **Total** | **10** | |
| Study of micro structure of | A. Prepare specimen | 05 | |
| | B. Handling microscope to observe C. microstructure | 02 | |

| Metals and alloys | D. Draw the microstructure of given material | 03 | |
|---|---|---|---|
| | **Total** | **10** | |

**COURSE CONTENTS:**

1. Determination of yield stress, ultimate stress, percentage of reduction in area, percentage of elongation, Young's modulus by conducting tension test on Universal testing machine.

2. Determination of crushing strength of concrete cube, cast iron, timber etc., using UTM/CTM

3. Determination of Young's Modulus by conducting flexural test on simply supported and cantilever beams of given material

4. Determination of Modulus of rigidity of spring steel by the deflection of springs.

5. Determination of impact strength of the material using Izod and Charpy's tests.

6. Determination of hardness of material using Brinell and Rockwell Testing methods.

7. Specimen preparation for the metallography.

8. Study of microstructures of Mild steel, Pure Iron, Grey Cast Iron, S.G. Iron, Eutectoid steel, Stainless steel, Aluminium, Brass, Bronze.

# FUELS LABORATORY PRACTICE

| Course Title | Course Code | Total No. of Periods | Total Periods Per Semester |
|---|---|---|---|
| Fuels Laboratory Practice | M – 309 | 03 | 45 |

## TIME SCHEDULE

| S. No. | EXERCISE TITLE | Periods |
|---|---|---|
| 1. | Flash & Fire point tests | 12 |
| 2. | Viscosity measurement | 12 |
| 3. | Calorific value tests | 09 |
| 4. | Carbon residue test | 09 |
| 5. | Calibration of Pressure Gauge | 03 |

## Course Objectives and Course Outcomes

| Course Objectives | | Upon completion of the course the student shall be able to:<br>(i) To familiarise with the knowledge of materials and tools used in measurement of fuel properties, calibration of pressure gauge<br>(ii) To reinforce the concepts of flash and fire points, viscosity, carbon residue, calorific value and calibration of pressure gauge by conducting corresponding experiments | |
|---|---|---|---|
| Course Outcomes | | | Upon completion of the course the student shall be able to: |
| | CO1 | M-309.1 | Demonstrate to determine the flash and fire points, viscosity, calorific value and carbon residue of a given sample of fuel using given apparatus. |
| | CO2 | M-309.2 | Demonstrate to calibrate the pressure gauge using deadweight pressure gauge |
| | CO3 | M-309.3 | Perform precise operations with the flash and fire point devices, viscometers, dead weight pressure gauge tester. |
| | CO4 | M-309.4 | Analyse the experimental results to draw inferences, to make recommendations |
| | CO5 | M-309.5 | Demonstrate ethics and etiquette while working in a group and display professionalism while communicating as a member and a leader in a group. |

## Learning Outcomes
Up on Completion of the course the student shall be able to:

**1.0 Conduct an experiment to determine the flash and fire point of a given sample of fuel using given apparatus**

1.1 Place the oil cup in the apparatus
1.2 Fill the water in water bath through funnel
1.3 Connect the equipment to the power supply

1.4  Fill the oil in the oil cup up to the gauge mark

1.5  Operate the shutter for opening and closing

1.6  Operate the shutter lid to observe vapours

1.7  Operate the stirrer

1.8  Apply the test flame

1.9   Identify the colour change of the flame

1.10 Record the two temperatures of flash and fire point

## 2.0 Conduct an experiment to determine viscosity of a given sample of oil using given apparatus

2.1      Move and place the collecting flask

2.2      Insert the thermometer and hydrometer in the device

2.3      Fill the oil in the oil cup up to the gauge mark

2.4      Operate the regulator to vary the temperature

2.5      Stir the water to get the uniform temperature

2.6      Record temperature using thermometer

2.7      Open and close the ball valve

2.8      Collect 50 ml of oil in the collecting flask

2.9      Record the time taken to collect 50 ml using stop watch

2.10      Document the readings systematically

2.11      Calculate the Viscosity

2.12      Sketch the related graphs

## 3.0 Conduct an experiment to determine the calorific value of a given sample of fuel using given apparatus

3.1 Set the thermometers, gas flow meter and regulator in position in the calorimeter

3.2 Move the measuring jar and stop watch in place for ready use

3.3 Operate the water tap for uniform flow of the water into the calorimeter

3.4 Operate the valve to get the uniform flow of gas into the calorimeter

3.5 Maintain constant pressure head in the gas meter by means of water column

3.6 Record the inlet and outlet temperature of water

3.7 Record time taken to consume volume of gas burnt and 1000 ml of water simultaneously

3.8 Record the barometer and manometer readings

3.9 Measure the weight of condensed steam

## 4.0 Conduct an experiment to determine the amount of carbon residue of a given sample of petroleum product

4.1 Place the wire mesh and asbestos block in their respective places

4.2 Cover all the crucibles with hood

4.3 Place the physical balance near the apparatus

4.4 Place inner crucible in outer crucible

4.5 Place sample oil in the porcelain crucible

4.6 Start the burner for heating the crucible

4.7 Stop the supply of fuel to the burner

4.8 Cool the crucible

4.9 Measure the weight of crucible before and after burning of oil

**5.0 Conduct an experiment to calibrate the pressure gauge.**

5.1 Place the open ended spanner and a needle puller for ready use

5.2 Place the can of gear near the apparatus

5.3 Insert and removal of dead weights on the plunger fat form

5.4 Set the levelling screws for exact levelling of the apparatus

5.5 Fill the oil reservoir without air bubbles by operating the cocks on either side of the oil reservoir

5.6 Operate the screw pump to generate and adjustment of system pressure

5.7 Observe and record the pressure due to mass load

5.8 Record the gauge pressure

**COURSE CONTENTS**

1. Determine the flash and fire points of the given sample of oil by using

    (a) Able's apparatus

    (b) Pensky Martens apparatus

    (c) Cleveland apparatus

2. Determine the viscosity of the given sample of oil by using

    (a) Redwood viscometer – I,

    (b) Redwood viscometer – II,

    (c) Saybolt viscometer

3. Determine the calorific value of given gaseous fuel by using Junker's gas Calorimeter.

4. Determine the carbon residue of given oil using Conradson's apparatus

5. Calibrate the given pressure gauge by using Dead Weight Pressure gauge.

# ELECTRICAL ENGINEERING LAB PRACTICE

| Course Code | Course Title | No. of periods / Week | Total No. of Periods | Marks for FA | Marks for SA |
|---|---|---|---|---|---|
| M310 | ELECTRICAL ENGINEERING LAB PRACTICE | 3 | 45 | 40 | 60 |

## COURSE OUTCOMES MAPPING

| S.No | EXERCICSE TITLE | No. of periods | CO's Mapped |
|---|---|---|---|
| 1. | Basic Electrical Wiring Circuits | 12 | CO1 |
| 2. | Identification and Testing the terminals of Starters, AC and DC Machines | 12 | CO2 |
| 3. | Speed Control of DC Shunt Motor | 06 | CO3 |
| 4 | Testing of Three Phase & Single Phase AC Motors | 09 | CO4 |
| 5. | Earthing System & Safety | 06 | CO5 |
| | **Total** | **45** | |

| COURSE OBJECTIVES | To familiarize the basic electrical Wiring Circuits |
|---|---|
| | To understand the how to test the Electrical Machines and starters. |
| | To gain the knowledge to operate different electrical equipment with safety. |

| | CO1 | M310.1 | Connect various electrical wiring circuits. |
|---|---|---|---|
| | CO2 | M310.2 | Measure the resistance between the terminals of various Electrical Machines. |
| **COURSE OUTCOMES** | CO3 | M310.3 | Draw the Speed Control Characteristics of DC Machines. |
| | CO4 | M310.4 | Draw the Performance Characteristics of AC Machines. |
| | CO5 | M310.5 | Install different Earthing Systems for electrical safety. |

**LEARNING OUTCOMES**

1.0 Basic Electrical Wiring Circuits

    1.1 Make a circuit with One lamp controlled by one switch with PVC surface conduit system

    1.2 Make a circuit with One lamp controlled by one switch and provision of 2/3-pin socket.

    1.3 Make a circuit for Stair case wiring and Go-down wiring

    1.4 Make the electrical wiring for Fluorescent Lamp

2.0 Identification and Testing of terminals of Starters, DC Machines and AC Machines

    2.1 Identifying the terminals and testing for its operation of Three Point and 4-Point starters.

    2.2 Identifying the terminals and testing for its operation of DOL (Direct On Line) starter and Star – Delta Starter.

    2.3 Identify of Terminals of the Following DC Machines with the Use of Test Lamp (a) DC Shunt Motor (ii) DC Series Motor (iii) DC Compound Motor

    2.4 Measuring the values of Insulation Resistance of the Following DC Machines with the Use of Megger.
        (a) DC Shunt Motor (ii) DC Series Motor (iii) DC Compound Motor

    2.5 Identify of Terminals of the Following AC Machines with the Use of Test Lamp
        (a) 3-Phase Squirrel Cage Induction Motor (ii) 3- Phase Slip Ring Induction Motor.

    2.6 Measuring the values of Insulation Resistance of the Following DC Machines with the Use of Megger.
        (a) 3-Phase Squirrel Cage Induction Motor (ii) 3- Phase Slip Ring Induction Motor.

**3.0 Speed Control of D.C Shunt Motor**

    3.1 Draw the Speed Control Characteristics of DC Shunt Motor By Armature Control method.

    3.2 Draw the Speed Control Characteristics of Dc Shunt Motor By Field flux Control method.

**4.0 Testing of Three Phase & Single Phase AC Motor.**

    4.1 Draw the Performance Characteristics (Speed, Efficiency) of Three Phase Squirrel cage Induction Motor by load test.

    4.2 Draw the Performance Characteristics of Single Phase AC Series Motor

    4.3 Draw the Performance Characteristics of Ac Single Phase Induction Motor.

**5.0 Earthing System & Safety**

    5.1 Measure the earth resistance at the Place of Pipe Earthing System or Plate Earthing system Using earth Megger .

    5.2 Demonstrate the Procedure of First Aid on Electric Shock.

**COURSE CONTENT**

### 1.0 Basic Electrical Wiring Circuits

One lamp controlled by one switch- One lamp controlled by one switch and provision of 2/3-pin socket - Stair case wiring and Godown wiring-Practicing the wiring for Fluorescent Lamp

### 2.0 Identification and Testing of terminals of Starters, DC Machines and AC Machines

Identifying the terminals and testing for its operation of Three Point and 4-Point starters-Identifying the terminals and testing for its operation of DOL ( Direct On Line) starter and Star – Delta Starter- Identify of Terminals and Measuring the Insulation Resistance of DC Shunt, Series & Compound Motors with the Use of Test Lamp and Megger - Identify of Terminals And measuring Insulation Resistance of the AC Squirrel Cage and Slip-Ring Induction Motors with the Use of Test Lamp and megger.

### 3.0 Speed Control Of DC Shunt Motor:

Speed Control Characteristics of DC Shunt Motor By Armature Control method and by Field flux Control method.

### 4.0 Testing of Three Phase & Single Phase AC Motor.

Draw the Performance Characteristics (Speed, Efficiency) of Three Phase Squirrel cage Induction Motor by load test-Draw the Performance Characteristics of Single Phase AC Series Motor -Draw the Performance Characteristics of Ac Single Phase Induction Motor.

### 5.0 Earthing System & Safety

Measure the earth resistance at the Place of Pipe Earthing System or Plate Earthing system Using earth Megger - Demonstrate the Procedure of First Aid on Electric Shock.

# WORKSHOP PRACTICE-I

| Course Title | Course Code | Periods/Week | Periods Per semester |
|---|---|---|---|
| Workshop Practice-I | M -311 | 03 | 45 |

## TIMESCHEDULE

| S.No | EXERCISE TITLE | No of Periods |
|---|---|---|
| 1. | Foundry | 18 |
| 2. | Machining | 18 |
| 3. | Welding | 9 |
| | Total | 45 |

## Course Objectives and Course Outcomes

| | | | |
|---|---|---|---|
| **Course Objectives** | | (i) To Familiarize tools used in Foundry, Machine shop and Welding<br>(ii) To handle the tools appropriately and safely<br>(iii) To reinforce theoretical concepts by practising relevant exercises of foundry, machine shop and welding<br>(iv) Obtain skill in mould Preparation, casting, machining and arc welding | |
| **Course Outcomes** | CO1 | M-311.1 | Prepare a casting for the given pattern |
| | CO2 | M-311.2 | Demonstrate the turning operations on Lathe |
| | CO3 | M-311.3 | Demonstrate the joining of metals by Arc Welding |
| | C04 | M-311.4 | Demonstrate ethics and etiquette while working in a group and display professionalism while communicating as a member and a leader in a group. |

## Learning Outcomes:

### Perform mould preparation for Solid Bearing
1.1 Write the sand moulding procedures in foundry.
1.2 Prepare a mould sand mix.
1.3 Identify various tools used in foundry shop.
1.4 Select the moulding boxes
1.5 Prepare a mould ready for casting with proper provision for runners, risers and gates
1.6 Locate the cope over the drag without any mismatch

### Perform mould preparation for Flange Coupling
2.1 Write the sand moulding procedures in foundry.
2.2 Prepare a mould sand mix.

2.3 Identify various tools used in foundry shop.
2.4 Select moulding boxes
2.5 Prepare a mould ready for casting with proper provision for runners, risers and gates
2.6 Locate the cope over the drag without any mismatch

## Perform mould preparation for Split Bearing
3.1 Write the sand moulding procedures in foundry.
3.2 Prepare a mould sand mix.
3.3 Identify various tools used in foundry shop.
3.4 Select moulding boxes.
3.5 Prepare a mould ready for casting with proper provision for runners, risers and gates
3.6 Locate the cope over the drag without any mismatch

## Perform mould preparation for Connecting Rod
4.1 Write the sand moulding procedures in foundry.
4.2 Prepare a mould sand mix.
4.3 Identify various tools used in foundry shop.
4.4 Select moulding boxes.
4.5 Prepare a mould ready for casting with proper provision for runners, risers and gates
4.6 Locate the cope over the drag without any mismatch

## Perform mould preparation for V-Pulley
5.1 Write the sand moulding procedures in foundry.
5.2 Prepare a mould sand mix.
5.3 Identify various tools used in foundry shop.
5.4 Select moulding boxes.
5.5 Prepare a mould ready for casting with proper provision for runners, risers and gates
5.6 Locate the cope over the drag without any mismatch

## Perform mould preparation for Gear Pulley
6.1 Write the sand moulding procedures in foundry.
6.2 Prepare a mould sand mix.
6.3 Identify various tools used in foundry shop.
6.4 Prepare mould in two boxes, three boxes.
6.5 Prepare a mould ready for casting with proper provision for runners, risers and gates
6.6 Locate the cope over the drag without any mismatch

## Perform Plain Turning Operations
7.1 Select proper tool to perform the job.
7.2 Centre the job by dial gauge
7.3 Select the suitable speed for different operations
7.4 Practice plain turning operation on a lathe machine
7.5 Use measuring instruments for taking dimensions.

**Perform Step Turning Operations**

8.1 Select proper tool to perform the job.
8.2 Centre the job by dial gauge
8.3 Select the suitable speed for different operations
8.4 Practice step turning operation on a lathe machine
8.5 Use measuring instruments for taking dimensions

**Perform Taper Turning Operations**

9.1 Select proper tool to perform the job
9.2 Calculate the taper angle.
9.3 Perform job setting on Lathe machine
9.4 Perform step turning operation on lathe.
9.5 Practice different taper turning methods on lathe
9.6 Perform taper turning for the required tapers by swivelling the compound rest.
9.7 Use measuring instruments for taking dimensions

**Perform Collar Turning Operations**

10.1 Select proper tool to perform the job.
10.2 Perform job setting on the lathe machine
10.3 Select the suitable speed for different operations
10.4 Practice step turning operation on a lathe machine for collars
10.5 Use measuring instruments for taking dimensions.

**Perform Knurling Operations**

11.1 Select proper tool to perform the job.
11.2 Perform job setting
11.3 Perform tool setting
11.4 Centre the job by dial gauge
11.5 Select the suitable speed for different operations
11.6 Practice knurling operation on a lathe machine
11.7 Use measuring instruments for taking dimensions

**Perform Facing Operations**

12.1 Select proper tool to perform the job.
12.2 Perform job setting
12.3 Perform tool setting
12.4 Centre the job by dial gauge
12.5 Select the suitable speed for different operations
12.6 Practice facing operation on a lathe machine
12.7 Use measuring instruments for taking dimensions

**Welding beads layout**

13.1 Perform Edge preparation
13.2 Attach clamps on work pieces and grounding
13.3 Select the correct rod and amperage range for the work you are attempting. Rod Angle (lead angle).
13.4 Hold the electrode at suitable angle and distance with respect to the work piece to maintain the arc
13.5 Perform Arc welding

13.6    Identify the weld bead shape

**Perform Lap Joint**
14.1    Perform Edge preparation
14.2 Arrange the work pieces for lap joint
14.3Attach clamps on work pieces and grounding
14.4Select the correct rod and amperage range for the work you are attempting..
        Rod Angle (lead angle) ...
14.5Hold the electrode at suitable angle and distance with respect to the work
        piece to maintain the arc
14.6    Perform Arc welding
14.7Identify the weld bead shape

**Perform Butt Joint**
15.1 Perform Edge preparation
15.2 Arrange the work pieces  for butt joint
15.3 Attach clamps on work pieces and grounding
15.4 Select the correct rod and amperage range for the work you are attempting. ...
        Rod Angle (lead angle)
15.5 Hold the electrode at suitable angle and distance with respect to the work piece to maintain the arc
15.6 Perform Arc welding
15.7 Identify the weld bead shape
15.8 Perform spot welding

**Perform T- Joint**
16.1 Perform Edge preparation
16.2 Arrange the work pieces for T-joint
16.3 Attach clamps on work pieces and grounding
16.4 Select the correct rod and amperage range for the work you are attempting. ...
        Rod Angle (lead angle)
16.5 Hold the electrode at suitable angle and distance with respect to the work piece to maintain the arc
16.6 Perform Arc welding
16.7 Identify the weld bead shape

**COURSE CONTENT**
   **1   Foundry**
      Moulding and casting of
      1.1  Solid bearing
      1.2  Flange coupling
      1.3  Split bearing
      1.4  Connecting rod
      1.5  V – Pulley
      1.6  Gear pulley
   **2   Machine Shop (Turning)**
      2.1  Plain Turning

2.2 Step Turning

2.3 Taper Turning

2.4 Turning Collars

2.5 Knurling

2.6 Facing

3. **Welding**

3.1 Layout of Beads

3.2 Lap joints

3.3 Butt joints.

3.4 T- joint

.

**REFERENCE BOOKS**

1. A text book of welding Technology –Khanna O.P. DhanpathRai Publications
2. Principles of Foundry Technology    by    P L Jain (McGraw Hill)
3. Workshop Practice Vol- II by HajraChoudhury Media Promoters and Publishers Pvt Ltd.

# IV SEMESTER

# DIPLOMA IN MECHANICAL ENGINEERING
## SCHEME OF INSTRUCTIONS AND EXAMINATIONS
### IV Semester

| Course Code | Course Title | Instruction period / week | | Total Period/ year | Scheme of Examination | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | | Theory | Practical / Tutorial | | Duration (hours) | Sessional Marks | End Exam Marks | Total Marks |
| THEORY | | | | | | | | |
| M – 401 | Engineering Mathematics - III | 3 | - | 45 | 3 | 20 | 80 | 100 |
| M – 402 | Design of Machine Members | 5 | - | 75 | 3 | 20 | 80 | 100 |
| M – 403 | Hydraulics & Fluid Power Systems | 5 | - | 75 | 3 | 20 | 80 | 100 |
| M – 404 | Heat Power Engineering-I | 5 | - | 75 | 3 | 20 | 80 | 100 |
| M – 405 | Energy Sources and power plant Engineering | 4 | - | 60 | 3 | 20 | 80 | 100 |
| M – 406 | Production Technology -II | 5 | - | 75 | 3 | 20 | 80 | 100 |
| PRACTICAL | | | | | | | | |
| M – 407 | Production Drawing | - | 3 | 45 | 3 | 40 | 60 | 100 |
| M – 408 | Communication Skills Lab Practice | - | 3 | 45 | 3 | 40 | 60 | 100 |
| M – 409 | Thermal Engineering Lab Practice | - | 3 | 45 | 3 | 40 | 60 | 100 |
| M – 410 | Hydraulics & Fluid Power Systems Lab Practice | - | 3 | 45 | 3 | 40 | 60 | 100 |
| M-411 | Workshop Practice-II | - | 3 | 45 | 3 | 40 | 60 | 100 |
| TOTAL | | 27 | 15 | 630 | | 320 | 780 | 1100 |

# C-20
## ENGINEERING MATHEMATICS-III

| Course Code | Course Title | No. of Periods/week | Total No. of periods | Marks for FA | Marks for SA |
|---|---|---|---|---|---|
| M-401 | Engineering Mathematics-III | 3 | 45 | 20 | 80 |

| S.No. | Unit Title | No. of periods | COs mapped |
|---|---|---|---|
| 1 | Higher order Linear Differential equations with constant coefficients | 15 | CO1 |
| 2 | Laplace Transforms | 18 | CO2 |
| 3 | Fourier Series | 12 | CO3 |
| | Total Periods | 45 | |

| | |
|---|---|
| **Course Objectives** | (i) To learn the principles of solving differential equations of second and higher order. <br> (ii) To comprehend the concept of Laplace transformations and inverse Laplace transformations. <br> (iii) To understand the concept of Fourier Series expansion of functions. |

| | | |
|---|---|---|
| **Course Outcomes** | CO1 | Solve homogeneous and non-homogeneous differential equations of second and higher order. |
| | CO2 | Find Laplace and inverse Laplace transforms of various functions. |
| | CO3 | Expand given functions as Fourier series and half- range Fourier Sine and Cosine series. |

# ENGINEERING MATHEMATICS – III
## Learning Outcomes
### Unit-I
### Differential Equations of higher order

**C.O. 1 Solve homogeneous and non-homogeneous differential equation of second and higher order.**

**L.O** 1.1 Solve Differential equations of the type $(aD^2 + bD + c) y = 0$ where a, b, c are real numbers and provide examples.

1.2 Solve higher order homogeneous differential equations with constant coefficients and provide examples.

1.3 Define complementary function, particular Integral and general solution of a non-homogeneous differential equation.

1.4 Describe the methods of solving $f(D) y = X$ where $f(D)$ is a polynomial of $n^{th}$ order and $X$ is a function of the forms $k, \ e^{ax}, \ \sin ax, \cos ax, \ x, x^n$ and their linear combinations where n is a positive integer, with examples.

### Unit-II
### Laplace Transforms

**C.O. 2 Find Laplace and inverse Laplace transforms of various functions.**

**L.O.** 2.1 Define Laplace Transform and explain the sufficient conditions of existence of Laplace Transform.

2.2. Obtain Laplace transforms of standard functions and solve simple problems.

2.3 Write the properties of Laplace Transform – Linearity property, First shifting theorem (without proof) and Change of Scale property and solve simple problems.

2.4. Write the Laplace Transform of unit step function and second shifting theorem (without proof) and solve simple problems.

2.5. Write formulae for Laplace transform of functions with multiplication by $t^n$ and division by t, Laplace transform of derivatives, evaluation of some definite integrals using Laplace Transforms and solve simple problems.

> Syllabus for Unit test-I completed

2.6 Define inverse Laplace Transform, obtain inverse Laplace Transforms of standard functions and solve simple problems.

2.7 Write linearity property, first and second shifting theorems (without proof), change of scale property of inverse Laplace transform and solve simple problems.

2.8 Write inverse Laplace transforms of derivatives and integrals and solve simple problems.

2.9 Write inverse Laplace transforms of functions with multiplication by s and division by s and solve simple problems.

2.10 Write inverse Laplace transforms of functions using partial fractions and solve some simple problems.

2.11 Define convolution of two functions, state convolution theorem (without proof) and solve simple problems.

## Unit-III
## Fourier series
### C.O. 3 Expand given functions as Fourier series and half- range Fourier Sine and Cosine series

**L.O**. 3.1 Define the orthogonality of functions in an interval.

3.2 Define Fourier series of a function in the intervals $(c,\ c+2\pi)$ and $(c,\ c+2l)$ and write the Euler's formulae for determining the Fourier coefficients.

3.3 Write sufficient conditions for the existence of Fourier series expansion of a function.

3.4 Find Fourier series of simple functions in the range (0 , 2π) and (-π , π)

3.5 Write Fourier series for even and odd functions in the interval $(-\pi,\ \pi)$ and $(-l, l)$ expand simple functions.

3.6 Write Fourier series expansion of a function over the interval (0, 2l) and $(-l,\ l)$ and expand simple functions.

3.7 Write half-range Fourier sine and cosine series of a function over the interval (0, π) and $(0,\ l)$ and expand simple functions.

> Syllabus for Unit test-II completed

## ENGINEERING MATHEMATICS – III
### (Common Course)
### Course Content

**Unit I: Differential Equations of higher order**

1. Solve Homogenous linear differential equations with constant coefficients of order two and higher with emphasis on second order.

2. Solve Non-homogenous linear differential equations with constant coefficients of the form f(D)y = X where X is in the form k(constant), $e^{ax}$, sinax, cosax, $x^n$, where n is a positive integer, finding complimentary function, particular integral and general solution.

**Unit II: Laplace Transforms**

3. Definition, sufficient conditions for existence of LT, LT of elementary functions, linearity property, state first shifting theorem, change of scale property, multiplication by $t^n$, division by t, LT of derivatives and integrals, LT of unit step function, state second shifting theorem, inverse Laplace transforms- state shifting theorems and change of scale property, multiplication by $s^n$ and division by s, derivatives, integrals, examples of inverse LT using partial fractions, state convolution theorem with simple examples.

**Unit III: Fourier series**

4. Orthogonality of trigonometric functions, Representation of a function in Fourier series over the interval $(c,\ c+2\pi)$ and $(c,\ c+2l)$, Euler's formulae , sufficient conditions for existence of Fourier series expansion of a function, Fourier series expansion of basic functions limited to k(constant), $x, x^2, \sin ax, \cos ax, e^{ax}$ and their combinations over the intervals $(0, 2\pi), (-\pi, \pi), (0, 2l), (-l, l)$ , Fourier series for

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even and odd functions over $(-\pi, \pi)$ and $(-l, l)$, Fourier half-range sine and cosine series over $(0, \pi)$ and $(0, l)$

**Textbook:**
Engineering Mathematics-I, a textbook for first year diploma courses, prepared & prescribed by SBTET, AP.

**Reference Books:**
1. B.S.Grewal, Higher Engineering Mathematics, Khanna Publishers
2. M.R. Spiegel, Schaum's Outline of Laplace Transforms, Schaums' Series
3. M.Vygodsky, Mathematical Handbook: Higher Mathematics, Mir Publishers, Moscow.

**Blue print**

| S. No | Chapter/ Unit title | No of Periods | Weightage allotted | Marks wise distribution of weightage | | | | Question wise distribution of weightage | | | | COs mapped |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | R | U | Ap | An | R | U | Ap | An | |
| 1 | Unit – I Higher order Linear Differential equations with constant coefficients | 15 | 28 | 11 | 11 | 3 | 3 | 2 | 2 | 1 | 1 | CO1 |
| 2 | Unit - II Laplace Transforms | 18 | 33 | 11 | 11 | 11 | 0 | 2 | 2 | 2 | 0 | CO2 |
| 3 | Unit - III Fourier Series | 12 | 19 | 3 | 3 | 3 | 10 | 1 | 1 | 1 | 1 | CO3 |
| | Total | 45 | 80 | 25 | 25 | 17 | 13 | 5 | 5 | 4 | 2 | |

R: Remembering Type      : 25 Marks
U: understanding Type     : 25 Marks
Ap: Application Type       : 17 Marks
An: Analysing Type        : 13 Marks

**C-20**
**ENGINEERING MATHEMATICS – III**
**Unit Test Syllabus**

| Unit Test | Learning Outcomes to be Covered |
|---|---|
| **Unit Test-I** | From LO 1.1 to 2.5 |
| **Unit Test-II** | From LO 2.6 to 3.7 |

## Design of Machine Members

| Course Title | Course Code | Periods/Week | Periods/Semester |
|---|---|---|---|
| Design of Machine Members | M – 402 | 05 | 75 |

## TIME SCHEDULE

| S. No | Chapter/Unit Title | Periods | Weightage of Marks | Short Answer Questions (3M) | Essay Type Questions (8M) | Higher Order Question (10M)) |
|---|---|---|---|---|---|---|
| 1 | Introduction to Machine Design | 05 | 06 | 2 | - | |
| 2 | Bolted Joints | 12 | 14 | 2 | 1 | |
| 3 | Riveted Joints and Welded Joints | 18 | 14 | 2 | 1 | |
| 4 | Shafts, Keys and Couplings | 18 | 14 | 2 | 1 | 1 |
| 5 | Bearings & Springs | 22 | 22 | 2 | 2 | |
| | **Total** | **75** | **70+10** | **10** | **5** | **1** |

**Note: 10 Marks higher order question may be given from the Chapter - 3 or 4 .**

### Course Objectives and Course Outcomes

| Course Objectives | Upon completion of the course the student shall be able to Understand the design philosophy and design the basic machine elements like shafts, keys, couplings, bearings, springs, bolted, riveted and welded joints | | |
|---|---|---|---|
| Course Outcomes | CO1 | M-402.1 | Explain the importance of principal stresses and theories of elastic failure in the design of machine members |
| | CO2 | M-402.2 | Design the temporary and permanent joints used in mechanical engineering equipments |
| | CO3 | M-402.3 | Calculate the  stresses in the machine elements |
| | CO4 | M-402.4 | Design the machine elements like 1.shafts, 2.Keys, 3.couplings, 4.bearings and 5.springs |

**Model Blue Print of the Question Paper**

| S. No | Chapter/Unit Title | Periods Allocated | Weightage Allocated | Marks Wise Distribution of Weightage | | | | Question Wise Distribution of Weightage | | | | CO's Mapped |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | R | U | Ap | An | R | U | Ap | An | |
| 1 | Introduction to Machine Design | 05 | 06 | 3 | 3 | - | - | 1 | 1 | - | - | CO1 |
| 2 | Bolted Joints | 12 | 14 | 3 | 3 | 8 | - | 1 | 1 | 1 | - | CO1, CO2, CO3 |
| 3 | Riveted Joints and Welded Joints | 18 | 14 | 3 | 3 | 8 | - | 1 | 1 | 1 | - | CO2, CO3 |
| 4 | Shafts, Keys and Couplings | 18 | 14 | 3 | 3 | 8 | 10 | 1 | 1 | 1 | 1 | CO1, CO3, CO4 |
| 5 | Bearings & Springs | 22 | 22 | 3 | 3 | 16 | - | 1 | 1 | 2 | - | CO3, CO4 |
| | **Total** | **75** | **80** | **15** | **15** | **40** | **10** | **05** | **05** | **05** | **01** | |

R-Remembering;      U-Understanding;      Ap-Applying;      An- Analylising

**Note:  10 Marks higher order question may be given from the Chapter - 3 or 4 .
( Here it is taken from the Chapter – 4).**


**LEARNING OUTCOMES**
Upon completion of the course the student shall be able to

**1.0 Introduction to Machine Design**

    1.1    Explain the basic procedure of machine design.
    1.2    Explain the basic requirements of machine elements and the factors affecting their design
    1.3    Explain the concept of principal stresses.
    1.4    Write the expressions for principal stresses in two-dimensional cases. **(Problems are omitted)**
    1.5    Explain the importance of theories of elastic failure in machine design.
    1.6    Write the statements and equations for five theories of elastic failure. **(Problems are omitted)**

**2.0 Bolted Joints**

    2.1    Classify the fasteners or Joints.
    2.2    State the advantages, disadvantages and applications of screwed joints.
    2.3    Explain screw thread nomenclature and specification of screw threads.
    2.4    Classify different forms of threads and threaded fasteners with legible sketches.

2.5     Explain the stresses induced in the bolted joints.
2.6     Modes of failure of bolts.
2.7     Design of bolts subjected to tensile load only – simple problems.
2.8     Design the bolts for steam cylinder covers – simple problems.
2.7     Design the eye bolt used for lifting the given load.
2.8     Draw an eye bolt (not to scale) showing the proportions.

## 3.0 Riveted and Welded Joints

3.1     List the basic types of riveted joints.
3.2     Explain with legible sketch the terms used in riveted joints
3.3     Explain the modes of failures in riveted joints
3.4     Calculate the strength and efficiency of riveted joint
3.5     Design a riveted joint under the given conditions (problems on direct loading only)
3.6     Explain the concept of Diamond or Lozenge joint
       **(problems are omitted)**
3.7     List the types of welded joints and their symbols.
3.8     Explain the terms related to welded joints.
3.9     Write the advantages and disadvantages of welded joints.
3.10    Design the butt, parallel and transverse fillet welded joints subjected to simple loading-Simple problems.

## 4.0 Shafts, Keys and Couplings

4.1     Define the terms i) shaft ii) axle
4.2     State the functions of i) shaft   ii) axle
4.3     List the standard sizes of shafts as per I.S
4.4     Write the formula for power transmitted by the shaft
4.5     Design the shaft subjected to i) only torsion ii) only bending iii) combined loading using Rankine and Guest theories.
4.6     Design the shaft against the rigidity
4.7     Compare the strength and rigidity of solid and hollow shafts
4.8     Explain the function of keys and their classification
4.9     List the recommended materials used for keys and splines.
4.10    Write the specifications of i) parallel   ii) Gib-head iii) taper sunk keys as per B.I.S.
4.11    Design the keys based on different modes of failure.
4.12    Design the keys based on empirical relations.
4.13    Explain the function of a coupling and their classification
4.14    Design the muff coupling, rigid flange coupling for a shaft of given size using empirical relations.

5.0 **Bearings & Springs**

    5.1     State the functions of bearing,
    5.2     Write the classification of bearings, their advantages, disadvantages and applications
    5.3     Explain the construction and working principle of journal bearing
    5.4     Terminology of journal bearing
    5.5     Design the simple journal bearing using McKee's equation and calculate the heat generated and heat dissipated **(problems on Artificial cooling are omitted).**
    5.6     List the types of thrust bearings
    5.7     Write the expressions for the load and torque carried by foot step and collar bearings under uniform pressure conditions.
    5.8     Write the expressions for the load and torque carried by foot step and collar bearings under uniform wear conditions.
    5.9     Solve simple numerical problems related to the design of thrust bearings.
    5.10   Rolling contact bearings – classification, advantages, disadvantages and applications.
    5.11   Components of rolling contact bearings – Specification of rolling contact bearings.
    5.12   Comparison between sliding and rolling contact bearings.
    5.13   State the functions of springs and their classification
    5.14   Explain the nomenclature of the helical spring
    5.15   Write the expressions for the stresses and deflections of closely coiled helical springs
    5.16   Design the helical spring – Simple problems.
    5.17   Write the types of leaf springs and their applications.
    5.18   Write the expressions for the stresses and deflections of semi-elliptical leaf springs.
    5.19   Design the semi - elliptical leaf spring- Simple problems.

## COURSE CONTENT

**1.     Introduction**

Machine Design – Types of machine design - Factors governing the design of a machine element - General sequence of steps in designing a machine element – Need of standard data and data hand books;

Types of Stresses in design – Stress systems – Uni-axial, Bi-axial and Tri-axial- Graphical representation of the above three stresses - Principal stresses and their importance in machine design – Mathematical formulae for maximum principal stress, minimum principal stress and maximum shear stress acting on a bi-axial system. **(Theoretical concepts only - Problems omitted)**

Theories of elastic failure-Definition and their mathematical statements only. **(Theoretical concepts only - Problems omitted)**

2.    **Bolted Joints**

Types of joints –advantages of bolted joints over riveted and welded joints - Nomenclature of thread - Different types of thread forms – specification of bolt;
Types of screw fasteners – lock nuts - Bolts of uniform strength;
Stresses in bolts due to initial tightening and external forces – Stresses due to combined forces – simple problems.
Design of bolts used in steam generating cylinder covers and boiler stays- Simple problems;
Design of eye bolt and sketching the eye bolt for a given load using empirical proportions – Simple problems;

3.    **Riveted Joints and Welded Joints**

Types of Riveted joints – advantages of riveted joints over bolted and welded joints - Terms related to riveted joints - Modes of failure of riveted joints - Strength and Efficiency of joints - Simple problems on lap joints and butt joints subjected to direct loading only.
Concept of Diamond or Lozenge joint **.( Problems are omitted)**
Types of Welded joints - Advantages and disadvantages over other joints - Terms related to weld –Standard location of Weld symbol –Strength of Butt-weld – Strength of Parallel Fillet weld – Strength of Transverse Fillet weld - Numerical problems on direct loading only. **(Problems on eccentric loading are omitted).**

4.    **Shafts, Keys and Couplings**

**Shafts :** Function of shafts and materials used for shafts - Standard sizes of shafts as per I.S. - Types of shafts - Design of solid and hallow shafts based on strength and rigidity using Rankine and Guest theories of failure Courseed to both torsion and bending moments - Comparison of solid and hallow shafts for the weight, power and strength - Numerical problems.
**Keys:** Function of keys and splines – classification of keys - Materials of keys and splines –Modes of failure of keys – Stresses in the keys - Design of a rectangular sunk key considering its failure against shear and crushing –- Design of rectangular sunk key using empirical proportions for given diameter of the shaft and Check for strength – simple problems.
**Couplings:** Function of coupling – types of couplings - Requirements of a good coupling - Calculation of proportions of a muff coupling (solid) for a given shaft size using empirical formulae, sketching the same from
 the computed dimensions – simple problems.
Rigid flange coupling: Calculation of dimensions for a C.I. flange coupling and coupling bolts for a given torque using empirical proportions for both protected and un-protected types – Simple Numerical problems.

## 5. Bearings

Functions and classification of bearings

Journal bearing – terminology – advantages, disadvantages and applications - McKee's Equation, Bearing Modulus -Power lost in friction – Design of journal bearing based on McKee's equation – Numerical problems.

Thrust bearing- Write the mathematical expressions for load carrying capacity, number of collars and power lost in flat pivot and flat collar bearings under the conditions of uniform pressure and uniform wear (**No derivations**) – Simple numerical problems.

Rolling contact bearings – Classification - applications - advantages and disadvantages - Components of rolling contact bearing - Specification of ball and roller bearings – comparison between sliding contact and rolling contact bearings.

## Springs

Functions of springs- classification of springs –spring materials – Nomenclature of helical spring – Write mathematical formulae for stress and deflection of closely coiled helical spring (**No derivations**) – Design of helical spring – spring diameter, spring index, number of turns, stiffness- Simple problems.

Nomenclature of semi-elliptic leaf spring - Write mathematical formulae for stress and deflection of semi-elliptic leaf spring (**No derivations**) – Design of leaf spring – load carrying capacity, number of leaves, stiffness – Simple problems.

## REFERENCES

1.    Design of Machine Elements    -    Pandya and Shah.
2.    Design of Machine Elements    –    V B Bhandari (MGH Publishers)
3.    Machine Design    -    R.S.Khurmi.

# HYDRAULICS & FLUID POWER SYSTEMS

| Course Title | Course Code | Periods/Week | Periods per Semester |
|---|---|---|---|
| Hydraulics & Fluid Power Systems | M-403 | 05 | 75 |

## TIME SCHEDULE

| S. No | Chapter/Unit Title | Periods | Marks Allocated | Short Answer Questions (3M) | Essay type Questions (8M) | Higher Order Question (10M) |
|---|---|---|---|---|---|---|
| 1 | Basics of Fluid Mechanics and Fluid Statics | 11 | 14 | 2 | 1 | |
| 2 | Fluid kinematics and Dynamics | 13 | 14 | 2 | 1 | |
| 3 | Flow through pipes | 11 | 11 | 1 | 1 | 1 |
| 4 | Hydraulic Machines | 32 | 20 | 4 | 1 | |
| 5 | Introduction to Fluid Power Engineering | 08 | 11 | 1 | 1 | |
| **Total** | | **75** | **70+10** | **10** | **05** | **01** |

**Note:  Higher order question (10 Marks) may be given from Chapter- 3 or 4.**

## Course Objectives and Course Outcomes

| | | Upon completion of the course the student shall be able to | |
|---|---|---|---|
| **COURSE OBJECTIVES** | | 01 | Understand the basic knowledge on properties of fluids, fluid statics, dynamics and various losses in flow through pipes |
| | | 02 | Understand the calculation of force exerted by jets in different cases. |
| | | 03 | Understand construction Details and working of Hydraulic Machines. |
| | | 04 | Understand the basic components of Fluid Power control systems. |
| **COURSE OUTCOMES** | CO1 | M-403.1 | Explain the basics of fluid Statics and Dynamics |
| | C02 | M-403.2 | Calculate Various Losses in flow through pipes |
| | C03 | M-403.3 | Describe the working of Hydraulic Turbines and Pumps |
| | C04 | M- | Solve the problems on  impact of jet on vanes, |

| | 403.4 | Hydraulic turbines and flow through pipes |
| CO5 | M-403.5 | Explain the layout and Functions of each component of Fluid power control systems |

**Model Blue Print of Question Paper**

| S. No | Chapter Name | Periods Allocated | Weightage Allocated | Marks Wise Distribution of Weightage | | | | Question Wise Distribution of Weightage | | | | CO's Mapped |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | R | U | Ap | An | R | U | Ap | An | |
| 1 | Basics of Fluid Mechanics and Fluid Statics | 11 | 14 | 3 | 3 | 8 | | 1 | 1 | 1 | - | CO1 |
| 2 | Fluid kinematics and Dynamics | 13 | 14 | 3 | 3 | 8 | | 1 | 1 | 1 | - | CO1 |
| 3 | Flow through pipes | 11 | 11 | | 3 | 8 | | | 1 | 1 | - | CO2 |
| 4 | Hydraulic Machines | 32 | 30 | | 12 | 8 | 10 | | 4 | 1 | 1 | CO3, CO4 |
| 5 | Introduction to Fluid Power Engineering | 08 | 11 | | 3 | 8 | | | 1 | 1 | - | CO5 |
| | **Total** | **75** | **80** | **6** | **24** | **40** | **10** | **2** | **8** | **5** | **1** | |

R-Remember;        U-Understanding;   Ap- Application ; An- Analylising

**Note:  Higher order question (10 Marks) may be given from Chapter- 3 or 4. ( Here it is taken from Chapter – 4)**

**Learning Outcomes:**

Upon the completion of the course the student shall be able to

**1.0 Understand the basics of fluid mechanics &Fluid Statics**

1.1 Define a fluid
1.2 Classify fluids
1.3 Define fluid mechanics
1.4 Classify fluid mechanics
1.5  Define statics, kinematics and dynamics
1.6  Define 1. Density   2. specific volume 3. Specific weight 4.  Specific gravity  5. Surface tension  6. Capillarity   7. Compressibility 8.bulk modulus and state formulae with units.
1.7  Define viscosity
1.8  State Newton's law of Viscosity
1.9  Define dynamic viscosity, kinematics viscosity and state their units
1.10 Differentiate between ideal fluid and real fluid
1.11  Differentiate between Newtonian and Non-Newtonian fluids with examples
1.12  Define fluid pressure and its units

1.13   Explain the difference between absolute pressure, atmospheric pressure, gauge pressure and vacuum pressure

1.14   Explain pressure head of a liquid

1.15   State Pascal's law

1.16   Classify pressure measuring instruments

1.17   Explain simple and differential U-Tube manometers with sketches and Solve Simple  problems

1.18   Explain the construction and working principle of Bourdon tube

## 2.0   Fluid kinematics and Fluid Dynamics

2.1   State types of fluid flow

2.2   Define steady flow and unsteady flow Define uniform flow and non-uniform flow one, two and three dimensional flow rotational and irrotational flow, laminar and turbulent flow compressible and incompressible flows

2.3   Flow pattern: path line, stream line and streak lines

2.4   Define rate of flow or discharge

2.5   State law of continuity and explain continuity equation and Solve simple problems on discharge and law of continuity.

2.6 Mention and explain types of head of liquid in motion

2.7 Explain potential energy, kinetic energy, pressure energy and total head

2.8 State Bernoulli's theorem

2.9 Explain Bernoulli's equation (without proof)

2.10 State the assumptions made in Bernoulli's theorem

2.11 Mention the practical applications of Bernoulli's theorem

2.12  Explain horizontal venturimeter, orifice meter and pitot's tube with expressions for discharge

2.13 Simple Problems on Bernoulli's theorem, Venturimeter.

## 3.0 Flow through pipes

3.1 Define loss of head in pipes

3.2 Mention major energy losses and minor energy losses

3.3 Define loss of head in pipes due to friction (major energy losses)

3.4 State the Darcy- Weisbach's formula (without proof)

3.5 Pipes in series, parallel and Equivalent pipes

3.6 State the condition for maximum transmission of power (without proof)

3.7 Explain the maximum efficiency of transmission of power

3.8 Solve simple problems on Power Transmission

## 4.0 Hydraulic Machines

4.1 Derive an expression for the force of jet exerted on a fixed flat plate held normal to the jet

4.2 Derive an expression for the force of jet exerted on a fixed flat plate held inclined to the jet

4.3 Derive an expression for the force of jet exerted on a fixed curved plate

4.4 Derive an expression for the force of jet exerted on a moving flat plate held normal to the jet

4.5 Derive an expression for the force of jet exerted on a moving flat plate held inclined to the jet

4.6 Derive an expression for the force of jet exerted on flat plates fixed on the rim of wheel

4.7 Explain power and efficiency of jet for all the above with formulae

4.8 Solve simple problems on the above

4.9 Explain the schematic layout of Hydraulic Power plant

4.10 Define gross head and net or effective head and state its formula

4.11 List the efficiencies of Hydraulic Turbines. Define hydraulic, mechanical, volumetric and overall efficiencies with formulae

4.12 Define and Classify hydraulic turbines

4.13 Describe Pelton wheel, Francis turbine, Kaplan turbine with a legible sketch.

4.14 Solve Simple problems on Work done and efficiency of Pelton Wheel Turbine only.

4.15 Explain the functions of penstock, surge tank and draft tube.

4.16 Define Unit power, unit speed and unit discharge- Specific speed

4.17 Compare impulse and reaction turbines

4.18 Define and Classify pumps.

4.19 Explain the Principle of operation and constructional details of a centrifugal pump

4.20 Define Work done by a centrifugal pump and state the formula (without proof)

4.21 State the various Heads of centrifugal pumps

4.23 Define and state the formula of Specific speed

4.24 Explain Priming of centrifugal pump.

4.25 Explain cavitation and its effects in centrifugal pump

4.26 Define and Classify Reciprocating pumps and state its applications.

4.27 Explain the Principle of operation, Constructional details and working reciprocating pumps

4.28 Expression for discharge, work done and Power required to drive a reciprocating pump (with-out derivation)

4.29 Explain Slip, Negative slip and co-efficient of discharge in reciprocating pump.

4.30 Differentiate centrifugal and reciprocating pumps
   **(Numerical Problems are omitted in Pumps)**

## 5.0 Introduction to Fluid Power Engineering
5.1 Explain the meaning of fluid power.

5.2 List out the Advantages and applications of fluid power

5.3 Differentiate between Hydraulics and Pneumatics

5.4 Explain hydraulic system with a schematic diagram

5.5 Explain Pneumatic system with a schematic diagram

5.6 Distinguish between open loop and closed loop systems

5.7 State the functions of Valves and Actuators.

5.8 Classify Valves and Actuators.

## Course Contents
## 1.0 Basics of fluid mechanics & Fluid Statics
Basics of Fluid Mechanics: Define a Fluid, properties of fluids: Definitions, units and formulae - Mass Density, Specific Volume, Specific Weight, Specific Gravity, Viscosity, Newton's law of viscosity, Kinematic Viscosity, variation of viscosity with temperature, cohesion and adhesion, Surface Tension, Capillarity, vapour pressure Compressibility and Bulk Modulus and their units, classifications of fluids, ideal and real fluids, Newtonian and non- Newtonian fluids, simple problems.

Fluid Statics: Definition of pressure and units of pressure , Relation between vacuum, absolute and atmospheric pressure , Pressure head of a liquid Pascal's law, Pressure measurement, pressure measuring instruments: Piezometer, Manometers –Simple U-tube   and Differential U-tube, Mechanical gauge: Construction and working of Bourdon tube, Simple problems on U-tube manometers.

### 2.0. Fluid Kinematics and Fluid Dynamics
**Fluid Kinematics** : Types of fluid flow , Steady and unsteady flow, Uniform and non-uniform flow  One, two and three dimensional flow, , laminar and turbulent flows, Rotational and  Irrotational flow , Compressible and in-compressible flow , Flow pattern: path line, stream line and streak lines , Rate of flow or discharge , Continuity equation , Simple problems .
**Fluid Dynamics:** Various forms of energy present in fluid flow, Pressure energy, Potential energy, Kinetic energy, total energy, Bernoulli's equation, assumptions made in deriving Bernoulli's equation, Flow measurements: coefficient of discharge of Venturi meter, Pitot's tube, Simple problems .

### 3.0 Flow through pipes
 Losses in pipe lines, minor losses in pipe lines: Loss due to sudden enlargement and sudden contraction, Major losses Loss of head in pipes due to friction, Darcy-Weisbach's formula (without proof), coefficient of friction and friction factor, pipes in series , pipes in parallel,  concept of equivalent pipe,   maximum power transmission, Hydraulic Gradient Line and Total Energy lines, power transmitted through the pipe, Condition for maximum power transmission, Simple problems.

### 4.0 Hydraulic Machines:
 **Impact of jet on Vanes**
Impulse-momentum principle, Force exerted by a jet striking normally on a fixed plate, inclined fixed plate, on fixed curved vane strikes at centre.  Force of jet on moving flat plate held normal to the jet, work done and efficiency. Simple Problems on impact of jets.
**Hydraulic turbines**
Schematics Layout of Hydraulic Power Plant, Types of heads ,Gross head , Net or effective head- definition and formula, Efficiencies with formula, Hydraulic Efficiency, Mechanical Efficiency, volumetric Efficiency, and  Overall Efficiency.
Definition of a Turbine, Classification of hydraulic turbine
**Impulse turbines:** Constructional details and working of a Pelton wheel (Impulse turbine), Work done and efficiency of Pelton wheel (Definition and formulae only) Hydraulic Efficiency, Mechanical Efficiency, volumetric Efficiency, and Overall Efficiency- related numerical problems.
**Reaction turbines** -Constructional details and working of Kaplan and Francis turbine, Work done and efficiency of Francis turbine, Use of penstock, surge tank and draft tube, Unit power, unit speed and unit discharge- Specific speed and their significance.  Comparison between impulse and reaction turbines
**Hydraulic pumps**
*a) Centrifugal Pumps*
Definition-pumps, Classification of pumps, differentiate positive and    non-positive displacement of pumps, Construction and operation of a centrifugal pump, Types of casing.  Work done by a centrifugal pump, Heads of centrifugal pumps, Efficiency,

Discharge and Power required in a centrifugal pump, Specific speed- definition and formula, Priming of centrifugal pump, Cavitations

*b) Reciprocating pumps*

Definition of Reciprocating pumps and its applications Types of reciprocating pumps Principle of operation, Constructional details and working Power required to drive a reciprocating pump single acting, double acting pump.  Slip, Negative slip and co-efficient of discharge in reciprocating pump. Comparison between centrifugal and reciprocating pumps

**5.0. Introduction to Fluid Power Engineering**

Definition of fluid power, advantages and applications of fluid power, Differentiate between Hydraulics and Pneumatics, components of hydraulic system with a schematic diagram, components of Pneumatic system with a schematic diagram, open loop and closed loop systems. Functions and Classifications of Control Valves and Actuators.

**REFERENCE BOOKS**

| | | | |
|---|---|---|---|
| 1 | Fluid Mechanics | Dr. A. K. Jain | Khanna Publishers, Delhi |
| 2 | Fluid Mechanics and Machinery | B C S  Rao | Tata  McGraw  Hill Publishers |
| 3 | Fluid Mechanics and Hydraulic Machines | R.K.Bansal | Laxmi Publications(P)Ltd New Delhi |
| 4 | Fluid Mechanics and Hydraulic Machines | Dr.D.S.Kumar | S.K      KATARIA &SONS.    New Delhi |

# HEAT POWER ENGINEERING-I

| Course Title | Course Code | Periods/Week | Periods per Semester |
|---|---|---|---|
| Heat Power Engineering-I | M-404 | 05 | 75 |

## TIME SCHEDULE

| S. No. | Chapter/Unit Title | Periods | Weightage of Marks | Short Answer Questions (3M) | Essay Type Questions (8M) | Higher Order Question (10M) |
|---|---|---|---|---|---|---|
| 1 | Combustion of Fuels | 12 | 14 | 02 | 01 | |
| 2 | Internal Combustion Engines | 20 | 14 | 02 | 01 | 01 |
| 3 | Performance of IC Engines. | 14 | 14 | 02 | 01 | |
| 4 | Air Compressors. | 15 | 14 | 02 | 01 | |
| 5 | Gas Turbines & Jet Propulsion. | 14 | 14 | 02 | 01 | |
| | Total | **75** | **70+10** | **10** | **05** | **01** |

**Note: 10 Marks higher order question may be given from the Chapter - 2 or Chapter - 3 or Chapter - 4.**

## Course Objectives and Course Outcomes

| Course Objectives | | Upon completion of the course the student shall be able to: Apply the principle and concepts of Heat Power Engineering to solve the contemporary real time applications | |
|---|---|---|---|
| **Course Outcomes** | CO1 | M-402.1 | Explain the combustion process of fuels |
| | CO2 | M-402.2 | Describe the working of I.C. Engines and various systems of I.C. Engines. |
| | CO3 | M-402.3 | Solve numerical problems related to performance of I.C. Engines. |
| | CO4 | M-402.4 | Describe the working of Air compressors and solve numerical problems. |
| | CO5 | M-402.5 | Describe the working of Gas turbines and Jet propulsion |

**Model Blue Print of a Question Paper**

| Sl. No | Chapter/ Unit Title | Periods Allocated | Weightage Allocated | Marks Wise Distribution of Weightage | | | | Question Wise Distribution of Weightage | | | | CO's Mapped |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | R | U | Ap | An | R | U | Ap | An | |
| 1 | Combustion of Fuels | 12 | 14 | 03 | 03 | 08 | | 01 | 01 | 01 | | CO1 |
| 2 | Internal Combustion Engines | 20 | 24 | 03 | 03 | 08 | | 01 | 01 | 01 | 01 | CO2 |
| 3 | Performance of I.C Engines | 14 | 14 | 03 | 03 | 08 | | 01 | 01 | 01 | | CO3 |
| 4 | Air Compressors | 15 | 14 | 03 | 03 | 08 | 10 | 01 | 01 | 01 | | CO4 |
| 5 | Gas Turbines & Jet Propulsion. | 14 | 14 | 03 | 03 | 08 | | 01 | 01 | 01 | | CO5 |
| | TOTAL | 75 | 80 | 15 | 15 | 40 | 10 | 05 | 05 | 05 | 01 | |

R-Remember;     U-Understanding;   Ap-Application ; An- Analylising

**Note:  10 Marks higher order question may be given from the Chapter - 2 or Chapter - 3 or Chapter - 4 (Here it is taken from the chapter –2).**

**Learning Outcomes**
Upon on completion of the course the student shall be able to:

**1.0    Combustion of Fuels.**

1.1  Define Combustion, Products of Combustion
1.2 Balance of chemical Equations for the composition of unit mass/Unit Volume of the given fuel
1.3 Estimate the minimum air required for complete combustion of unit mass / unit volume of a fuel of given composition.
1.4 Estimate the percentage composition of dry products of flue gases by mass only during combustion.
1.5 Describe the working of Orsat's apparatus with a line diagram and summarize the procedure in conducting flue gas analysis by using Orsat's apparatus.

**2.0    Internal Combustion Engines**

2.1    Define "Heat Engine" and classify heat engines based on the location of furnace.
2.2    Give examples for the external combustion engines and internal combustion engines.
2.3    State the advantages of internal combustion engines over external combustion engines.

2.4 Classify Internal Combustion Engines based on number of strokes per cycle, type of fuel used, thermodynamic cycle, method of ignition, number of cylinders and arrangement of cylinders.

2.5 Draw the legible sketch of an I.C. engines and name the various parts.

2.6 Describe with line diagrams, the working of a four-stroke diesel engine.

2.7 Describe with line diagrams the working of a four-stroke petrol engine.

2.8 Describe with line diagrams the working of a two-stroke petrol engine.

2.9 Compare two stroke engines with four stroke engines

2.10 Draw the port time diagrams for two-stroke petrol engine and also draw valve time diagrams for four-stroke petrol and four-stroke diesel engines.

2.11 Describe the working of fuel system of diesel engine with a legible sketch.

2.12 Describe the working of fuel system of petrol engine with a legible sketch.

2.13 Describe the working of simple carburettor with a neat sketch.

2.14 Describe the working of Zenith carburettor with a neat sketch.

2.15 Explain different methods of cooling systems of I.C engines.

2.16 Explain different methods of Ignition systems of IC engine.

2.17 Explain different methods of lubricating systems in I.C. engines.

2.18 Explain different methods of governing of I.C. engines.

2.19 Concept of super charging in I.C. engines.

## 3.0 Performance of Internal Combustion Engines

3.1 State the objectives of testing an IC engine

3.2 List performance parameters of an IC engine.

**3.3** Write the mathematical formula for performance parameters of an IC engine **( no proofs) - simple problems on performance parameters**

3.4 Describe the Morse test on multi-cylinder engine - simple problems

3.5 Parameters of Heat balance sheet - simple problems.

## 4.0 Air compressors

**4**.1 List the functions of air compressors and the uses of compressed air.

4.2 Categorize the different types of compressors based on number of stages, principal of operation, pressure ratio, number of cylinders, method of cooling, .

4.3 Describe with a line diagram, the working of a single stage reciprocating air compressor.

4.4 State the formula for work done and power required by a single stage compressor. **(No derivation).**

4.5 Solve simple problems on single acting single stage reciprocating air compressors **(neglecting clearance volume).**

4.6 Summarize the advantages of multi- stage compressor over single stage compressor.

4.7 Explain the use of inter cooler.

4.8 Explain the condition for minimum work done in two stage compression.

4.9 State the formula for work required, minimum work required and power required in two stage compressor.**( no derivation)**

4.10 Solve simple problems on work required, minimum work required and power required in a two stage air compressor with or without perfect intercooling. **(Neglecting clearance volume).**

4.11 List the types of rotary compressors- Distinguish reciprocating air compressors with rotary air compressors.

4.12 Describe the working of a centrifugal compressor, an axial flow type compressor and a vane type compressor with a line diagram.

## 5.0    Gas turbines & Jet Propulsion.

5.1    Classify the gas turbines based on cycle of operation, thermodynamic cycle, fuel used and process of heat addition.

5.2    Differentiate the gas turbines with the I.C. engines.

5.3    State the advantages and limitations of gas turbine.

5.4    Describe with a line diagram, the working of an open cycle constant pressure type gas turbine.

5.5    Describe the working of a closed cycle type gas turbine with line diagram.

5.6    Draw the cycle of operation for the above type gas turbines on p-V and T-s diagrams.

5.7    Explain the concept of jet propulsion.

5.8    Describe the principle of operation of Ramjet engine with a line diagram.

5.9    Describe the principle of operation of Turbo- jet engine with a line diagram.

5.10   State the applications of jet engine.

5.11   Describe the working of a rocket engine with a line sketch.

5.12   List the fuels used in jet propulsion.


## COURSE CONTENT

## 1.0    Combustion of Fuels .

Introduction to combustion of fuel- Write Combustion chemical equations for the combustion of carbon, Hydrogen, sulphur, Methane, Ethane etc.

Mathematical expressions for calculation of minimum air required on mass basis and volume basis. **( No derivations)**

Calculation of minimum air required for the complete combustion of unit mass/unit volume of fuel having a given composition – Simple problems.

Calculation of Actual air required for the complete combustion of unit mass/unit volume of fuel having a given composition when excess air is supplied  – Simple problems.

Procedure for Conversion of volumetric analysis to gravimetric analysis, and vice-versa - simple problems.

Products of combustion - Calculation of percentage composition of dry flue gases by mass and volume (**neglecting wet products) -**  simple problems.

Brief description of Orsat's apparatus, procedure for determination of flue gas analysis, chemicals used for absorption of different gases in flue gases.

### 2.0    Internal Combustion Engines

Heat engines – Internal combustion engines and external combustion engines - advantages of I.C. engines over external combustion engines- classification of I.C. engines - neat sketch of I.C. engine indicating important parts - Function of each part and materials used for the  parts – Brief explanation on the working of four-stroke diesel engine, working of four stroke and two stroke petrol engines with line diagrams - Comparison of two stroke engines and four stroke engines - Comparison of diesel engine and petrol engine - Valve timing/port diesel and petrol engines.

Description with sketches of a diesel fuel system - fuel tanks, fuel filter, fuel pump and fuel injector - Description of petrol engine fuel system - functions of tank, fuel filter, fuel pump and carburettor - Working of a Zenith Carburettor (Line sketch) –

Cooling system of I.C. engines : air cooling, water cooling system with thermo siphon method of circulation and water cooling system with radiator and forced circulation (description with line diagram). Comparison of air cooling and water cooling system.

Ignition systems: Description and working Battery coil ignition and magneto ignition systems with line diagrams - Comparison of both systems.

Lubricating systems used in I.C. engines: Splash and Pressure systems with line diagrams. Governing of I.C. engines:  – Explanation of quantitative method and qualitative methods of governing (No sketches)

Super charging in I.C. Engines (Concepts only) - advantages.

### 3.0    Performance of Internal Combustion Engines.

Objectives – Mathematical Expressions for I.P, B.P, F.P, Mechanical efficiency, indicated thermal efficiency, Brake thermal efficiency, Air standard efficiency, Relative efficiency and Specific fuel consumption- Simple problems on the above parameters.

Procedure to conduct Morse test on multi cylinder petrol engine – Simple problems.

Calculation of parameters of Heat balance sheet – Simple problems.

### 4.0    Air Compressors.

Functions of air compressor – uses of compressed air – types of air compressors.-Single stage reciprocating air compressor its construction and working (with line-diagram) using p-V diagram.

Formulae for work required and power required **( No proof)** - simple problems on calculation of work done and power required for single acting single stage air compressors. **(neglecting clearance volume).**

Multi stage compressors – advantages over single stage compressors. Use of inter cooler  – Formulae for work done and power required in two stage compressors - conditions for minimum work in two stage compressor **(without proof).**

Solve simple problems on work required, minimum work required and power required in a two stage air compressor with or without perfect intercooling. **(neglecting clearance volume).**

Rotary compressors –-types – descriptive treatment of Centrifugal compressor, axial flow type compressor -and vane type compressors- differences between reciprocating and rotary air compressors.

**5.0  Gas Turbines & Jet Propulsion**

Gas turbines – Classification – open cycle gas turbines and closed cycle gas turbines – comparison of gas turbines with reciprocating I.C. engines. Applications and limitations of gas turbines. Open cycle constant pressure gas turbine – general layout, P.V. and T.S diagrams and working - Closed cycle gas turbine – P.V. and T.S diagrams – working. Principle of operation of Ram jet engine and Turbojet engines – application of jet engines.  Rocket engine – its principle of working & application. Fuels used in jet propulsion.

**REFERENCE BOOKS**

1.    R.S.Khurmi & J K Guptha, Thermal Engineering, 2006, S CHAND publishers
2.    Mahesh M Rathore, Thermal Engineering, 2010, MGH Publishers
3.    Mathur & Mehtha, Thermal Engineering, 2009, Jain Brothers
4.    Heywood, Internal Combustion Engines Fundamentals, 2017, MGH Publishers
5.    P.L.Ballaney, Thermal Engineering, 1966, Khanna Publishers

# ENERGY SOURCES & POWER PLANT ENGINEERING

| Course title | Course code | Periods per week | Periods per Semester |
|---|---|---|---|
| Energy Sources & Power Plant Engineering | M - 405 | 04 | 60 |

## TIME SCHEDULE

| S. No. | Chapter/Unit Title | Periods | Weightage of Marks | Short Answer Questions (3M) | Essay Type Questions (8M) | Higher Order Question (10M) |
|---|---|---|---|---|---|---|
| 1 | Introduction to Renewal Sources of Energy | 10 | 9 | 3 | - | |
| 2 | Solar and Wind Energy | 14 | 22 | 2 | 2 | |
| 3 | Fuel Cells and MHD Generator | 10 | 11 | 1 | 1 | |
| 4 | Bio and Tidal Energy | 10 | 14 | 2 | 1 | 01 |
| 5 | Thermal and Nuclear Power Plants | 16 | 14 | 2 | 1 | |
| | **Total** | **60** | **70+10** | **10** | **5** | **01** |

**Note: 10 Marks higher order question may be given from the Chapter – 3 or Chapter-4 or Chapter- 5.**

**Course Objectives and Course Outcomes**

| Course Objectives | | | *Upon completion of the course the student shall be able to* <br> 1. Understand the need of Non-conventional energy sources. |
|---|---|---|---|
| | | | 2. Understand solar collectors, photo voltaic cells, horizontal axis and vertical axis wind mills. |
| | | | 3. Understand working of floating type and fixed dome digester, steam power plant layout, PWR, BWR. |
| **Course Outcomes** | CO1 | M – 405.1 | Explain the concept of solar collectors, solar pond, solar space heating, photovoltaic cells, solar water pumping, and horizontal axis and vertical axis wind mill |
| | CO2 | M – 405.2 | Explain the working principle of Fuel Cells and MHD Generator. |

| | CO3 | M – 405.3 | Describe the working of floating type digester, fixed dome digester and Tidal power plant |
|---|---|---|---|
| | CO4 | M – 405.4 | Describe the functions of elements of Thermal power plant, and Coal handling system, Ash handling system, |
| | CO5 | M – 405.5 | Describe the working of BWR and PWR power plants |

**Model Blue Print of a Question Paper**

| Sl. No | Chapter/ Unit Title | Periods Allocated | Weightage Allocated | Marks Wise Distribution of Weightage | | | | Question Wise Distribution of Weightage | | | | CO's Mapped |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | R | U | Ap | An | R | U | Ap | An | |
| 1 | Introduction of Renewal Sources of Energy | 10 | 9 | 9 | | | | 3 | | | | CO1 |
| 2 | Solar and Wind Energy | 14 | 22 | 6 | | 16 | | 2 | | 2 | | CO1 |
| 3 | Fuel Cells and MHD Generator | 10 | 11 | 3 | | 8 | | 1 | | 1 | | CO2 |
| 4 | Bio and Tidal Energy | 10 | 14 | 6 | | 8 | | 2 | | 1 | | CO3 |
| 5 | Thermal and Nuclear Power Plants | 16 | 24 | 6 | | 8 | 10 | 2 | | 1 | 1 | CO4, CO5 |
| | TOTAL | 60 | 80 | 30 | | 40 | 10 | 10 | | 5 | 1 | |

R-Remembering;     U-Understanding;     Ap-Applying;     An- Analylising

**Note:  10 Marks higher order question may be given from the Chapter – 3 or Chapter-4 or Chapter- 5. ( Here it is taken from Chapter-5)**

**Learning Outcomes**
Upon completion of the course the student shall be able to:

**1.0    Introduction to renewable energy sources**

1.1    State various energy sources, give examples

1.2    Classify energy sources as renewable and non-renewable energy

1.3    State Advantages and disadvantages of renewable and non-renewable energy sources

1.4    Appreciate the need of renewable energy sources

1.5    State the different types of renewable energy sources

1.6    State alternate fuels for IC engines.

1.7    Explain the Properties and Methods of using Alcohols as fuels for IC engines.

1.8    Explain the Properties and Methods of using Vegetable Oils as fuels for IC engines.


**2.0    Solar and wind energy**

2.1    State the amount of solar radiation reaching the earth's surface, determine the solar constant, State the principle of measuring solar radiation by pyranometer and pyrheliometers.

2.2    State the principle of conversion of solar radiation into heat. Explain the function of liquid flat collector. Explain the working principle of solar air heater with a legible sketch, State any three applications of solar air heater.

2.3    Identify different types of concentrating collectors; explain the working principle of concentrating collector (focusing type parabolic trough collector and flat plate collectors with plain reflectors). State any three different methods of storing solar energy.

2.4    Explain the construction details and working principle with a sketch of following :
a) Solar pond & applications of solar pond.
 b) Different types of solar water heater.
 c) Solar still.

2.5    State the principle of photo –voltaic conversion.

2.6    State the working principle of a solar photovoltaic cell.

2.7     State any four considerations for site selection for installing wind mill.

2.8    Identify the basic components of a wind mill.

2.9    Explain the construction details on the working principle of the Horizontal and Vertical axis wind mills.


3.0    **Fuel Cells and MHD Generator**

3.1    State the working principle of fuel cell

3.2    Explain the construction details and working principle of Bacan's High pressure fuel cell with a legible sketch

3.3    State the different types of fuels used in fuel cells

3.4    Explain the working principle of aluminium air fuel cell with a legible sketch

3.5    Explain the working principle of MHD Generator a legible sketch

## 4.0 Bio and Tidal Energy

4.1 Define the terms bio-mass and bio-gas. State the principle of bio-gas generation. State the chemical composition and any two properties of bio-gas. List any four applications of bio-gas.

4.2 List any two different types of bio-gas plants. Explain the construction details and working principle of fixed dome type and floating dome type bio-gas plants with sketches.

4.3 State the different materials used for bio-gas generation. Express bio-gas plant capacity.

4.4 Identify the energy available in tides and its usefulness in conversion.

4.5 State the working principle of tidal power plant.

4.6 State the different operation methods of utilisation of tidal energy.

4.7 Explain single basin and double basin arrangements.

4.8 List any four site requirements for installation of tidal power plant.

4.9 List any three advantages and limitations of tidal power generation.


## 5.0 Thermal and Nuclear Power Plants

5.1 Draw the layout of a thermal power plant. Locate the Boiler, super heater, turbine , Electric Generator, Condenser and hot well pump in the layout. Explain function of circulating water pump, Economiser, Air pre heater, Soot – Blower.

5.2 Explain the dust extraction in Electrostatic precipitator.

5.3 Explain about the ash removal, water cooling. Explain about the feed water treatment.

5.3 Explain about the coal storage. Identify the coal handling equipment.

5.4 List nuclear fuels.

5.5 State any four characteristics of atomic power plants

5.6 Explain the working principle of a nuclear reactor.

5.7 Explain with the help of legible sketch the constructional details and the working principle of: PWR power plant.

5.8 Explain with the help of legible sketch the constructional details and the working principle of BWR power plant.

5.9 Explain about the nuclear power in India.


## COURSE CONTENT

**1.0 Introduction:** Various energy sources, Examples for energy sources, advantages and disadvantages, Need for alternate sources of energy – types of non conventional (renewable) energy sources – solar energy, wind energy, energy from bio- mass and bio-gas, tidal and wave energy, hydrogen energy, fuel cells. Alternate fuels for IC engines - Alcohols as fuels in IC engines - Properties of alcohols as fuels in IC engines. Methods of using alcohols in IC

engines; Vegetable Oils as Fuels in IC engines - Important properties, Different methods of using vegetable oils in IC Engines.


## 2.0   Solar and Wind Energy

Solar Radiation:– solar radiation at earth's surface – Instruments for measuring solar radiation – pyranometer, pyrheliometers.

### Solar Energy Collection
Principle of conversion of solar radiation into heat   liquid flat collectors - solar air heater
Application of solar air heater – concentrating collectors – (focusing type) –

### Solar Energy Storage
Methods of storing solar energy – solar pond – working principle and description of solar pond with a schematic diagram – applications of solar pond.

### Solar Energy Applications
i) Solar water heater – natural circulation type and forced circulation type.
ii) Solar still.

### Photo voltaic conversion
solar cell – working principle – Advantages and   disadvantages of solar energy.


### Wind Energy
Introduction – site selection considerations – basic components of a wind mill – construction details and working principles – types of wind mill – horizontal axis type and vertical axis type

## 3.0   Fuel Cells and MHD Generator

Working principle – Bacan's High pressure fuel cell – construction details and working principle – types of fuels used – Aluminium – air fuel cell working principle. Working principle of MHD Generator.


## 4.0   Bio and Tidal Energy

Bio Energy – Introduction to bio – mass bio-mass conversion into energy bio-gas generation – composition and properties of bio-gas – applications of bio-gas. Classification of bio-gas plants – continuous and batch type, the dome and drum type, floating gas holder and fixed dome type – construction details and working principle of fixed dome type and floating gas holder type bio – gas plants – materials used for bio-gas generation – capacity of bio-gas plant – starting of bio-gas plant.

**Tidal Energy :** Introduction to tidal power – components of tidal power plants – operation methods and utilisation of tidal energy – single basin and double basin arrangements- site requirements – advantages and limitations of tidal power generation.

### 5.0 Thermal and Nuclear Power Plants

#### Thermal Power Plants

Layout of a Thermal Power Plant, Choice of site, List the important elements in layouts:- Such as Boiler, Condenser , Feed water system, Circulating water pumps, Economiser, Air heater, Soot–Blower , Forced draught Fan, Induced draught Fan, Dust collectors, Electro static precipitator. Supporting activities: Such as Water cooling, Feed water treatment, Coal handling, Coal storage , Chimney.

#### Nuclear – Power Plants

Nuclear energy chain reaction , nuclear materials, reactor, characteristics of atomic power plants, nuclear fuels , working principle of nuclear reactor, classification of reactors, working principle of PWR and BWR nuclear power reactors.

**REFERENCE BOOKS**
1. Non-conventional Energy source by G.D Rai..... Khanna Publishers
2. Energy Technology by S. Rao & Dr. D.B. Palekr
   (Non-conventional, Renewable and conventional) ...... Khanna Publishers 2015
3. Solar energy utilisation by G.D.Rai ....... Khanna Publishers 1995
4. Introduction to alternate sources of energy by TTTI, Madras
5. Solar energy by S.P. Sukhatme ......... TMGH
6. Advances in bio-gas technology by O.P.Chawla...... Publications and information division Indian counsel of Research
8. Thermal Engineering by Arora & S. Domkundwar ... Lakshmi Publications.

# PRODUCTION TECHNOLOGY-II

| Course Title | Course Code | Periods Per Week | Periods Per Semester |
|---|---|---|---|
| Production Technology-II | M – 406 | 05 | 75 |

## TIME SCHEDULE

| Sl. No. | Chapter/Unit Title | Periods | Weightage of Marks | Short Answer Questions (3M) | Essay Type Questions (8M) | Higher Order Question (10M) |
|---|---|---|---|---|---|---|
| 1 | Milling | 20 | 14 | 02 | 01 | * |
| 2 | Gear Making | 12 | 14 | 02 | 01 | * |
| 3 | Grinding and finishing processes | 16 | 14 | 02 | 01 | |
| 4 | Jigs, Fixtures and Jig Boring | 12 | 14 | 02 | 01 | |
| 5 | Modern Machining Processes | 15 | 14 | 02 | 01 | * |
| | **Total** | **75** | **70+10** | **10** | **05** | **01** |

**Note:  * 10 Marks higher order question may be given from the Chapter- 1 or Chapter-2 or Chapter-6.**

## Course Objectives and Course Outcomes

| Upon completion of the course the student shall be able to | | | |
|---|---|---|---|
| **COURSE OBJECTIVES** | 01 | | Describe construction and working of milling machine and use of about various devices for milling operations, |
| | 02 | | Explain Gear manufacturing processes, Principles of Grinding and Finishing processes and use of various measuring instruments. |
| **COURSE OUTCOMES** | CO1 | M406-1 | Describe the constructional details of Milling machines. |
| | C02 | M406-2 | Explain various gear manufacturing methods. |
| | C03 | M406-3 | Describe the working of different grinding machines. Explain the principles of Finishing processes. |
| | C04 | M406-4 | Describe types of jigs and Fixtures and working principles of Jig boring machines. |
| | C05 | M406-5 | Describe the modern machining processes |

**Model Blue Print of Question Paper**

| Sl. No | Chapter / Unit Title | Periods Allocated | Weightage Allocated | Marks Wise Distribution of Weightage | | | | Question Wise Distribution of Weightage | | | | CO's Mapped |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | R | U | Ap | An | R | U | Ap | An | |
| 1 | Milling | 20 | 24 | 06 | | 08 | 10 | 2 | | 1 | 1 | CO1 |
| 2 | Gear Making | 12 | 14 | 06 | | 08 | | 2 | | 1 | | CO2 |
| 3 | Grinding and finishing processes | 16 | 14 | 06 | | 08 | | 2 | | 1 | | CO3 |
| 4 | Jigs , Fixtures and  Jig Boring | 12 | 14 | 06 | | 08 | | 2 | | 1 | | CO4 |
| 5 | Modern Machining Processes | 15 | 14 | 06 | | 08 | | 2 | | 1 | | CO5 |
| | **TOTAL** | **75** | **80** | **30** | | **40** | **10** | **10** | | **05** | **01** | |

R-Remembering;     U-Understanding;     Ap-Applying;     An- Analylising

**Note:  * 10 Marks higher order question may be given from the Chapter - 1 or 2 or 6. ( Here it is taken from Chapter – 1)**

**Learning Outcomes:**

Upon completion of the course the student shall be able to

**1.0.    Milling**

    1.1     Explain the working principle of a Milling machine
    1.2     List plain, Universal, vertical milling machines
    1.3     Describe the constructional details of milling machine with legible sketch
    1.4     Explain the procedure of simple, compound and differential indexing  milling  operations
    1.5     List three milling cutters
    1.6     Explain the nomenclature of teeth of milling cutter
    1.7     List three materials used for teeth
    1.8     Explain selection of tool and work holding devices.
    1.9     Explain the different indexing methods.
    1.10   Explain the specifications of milling machines.

**2.0.    Gear Making**

    2.1. List four methods of producing gears
    2.2. Explain the the Gear shaping

2.3. Identify various components of gear hob

2.4. Describe the working of gear hob with legible sketch

2.5. List sequence of operations in gear hobbing machine

2.6. Explain gear finishing processes

2.7. Explain methods of checking gear teeth dimensions

2.8. Explain Specifications of a gear

2.9. List three various gear materials

2.10. List three different heat treatment processes applied to gear

## 3.0. Grinding and finishing processes

3.1. Explain a)The principle of metal removal by grinding
   b) The working of Cylindrical and Principle of centre less grinding.

3.2. List a) Three different abrasives
   b) Types of bonds in grinding wheel.

3.3. Identify the grinding wheel from the standard code (Marking system or designation of wheel).

3.4. State the factors for selecting the grinding wheels.

3.5. state the methods of grinding,

3.6. Mention the advantages & limitations of centreless grinding.

3.7. State the methods of wheel maintenance.

3.8. Explain the principles of operations of Honing, Lapping, Super finishing processes, galvanising, tin coating, Parkerizing and anodising.

3.9. Describe a)The principle of electro–plating with a legible sketch.

3.10. List six various organic coatings

3.11. State a)The principles of metal spraying.

3.12. Select the appropriate process for surface roughness of a given application.

## 4.0   Jigs and Fixtures

4.1   List types of jigs and explain their constructional details with the help of legible sketches

4.2   State general considerations in design of drill jigs

4.3   State the function of drill bush.

4.4   List different types of fixtures and explain their constructional details with the help of legible sketches.

4.5   Differentiate jigs and fixtures.

4.6   List the advantages of Jigs and Fixtures

4.7   Explain basic principle of location.

4.8   Identify different locating methods and devices.

4.9   Explain the basic principle of clamping.

4.10   Identify different types of clamps and their constructional details with the help of legible sketches

4.11. State the principle of working of a jig boring machine.

4.12. Classify the jig boring machines.

4.13. Explain the constructional details and function of open front machine and cross rail type machine with the help of legible sketches.

4.14    Describe the systems of location of holes.

## 5.0. Modern Machining Process

5.1    Distinguish between non-conventional machining processes and traditional methods.
5.2    State the relative advantages of conventional and non-conventional machining processes.
5.3    Explain the principle of working of ultrasonic machining.
5.4    List the equipment used in U.S.M. processes.
5.5    Describe the principle of electric discharge machining with a legible sketch.
5.6    Describe the working of Abrasive jet machining with a legible sketch
5.7    Describe the working of Laser beam machining with a legible sketch
5.8    State the principle of chemical machining.

## COURSE CONTENT

### 1.0    Milling
Introduction. Types of milling machines: plain, Universal, vertical, constructional details – specifications. Milling operations.Indexing: simple, compound and differential indexing.Milling cutters – types – nomenclature of teeth – teeth materials.Tool signature of milling cutter.Tool& work holding devices.

### 2.0    Gear Making
Manufacture of gears – by casting, moulding – stamping – coining-extruding- rolling – Machining. Gear generating methods: Gear Shaping  with pinion cutter & rack cutter. Gear hobbing – Description of gear hob –Operation of gear hobbing machine.Gear finishing processes.Gear materials and specification. Heat treatment processes applied to gears.

### 3.0    Grinding and finishing processes
Introduction – principles of Metal Removal by Grinding. Abrasives – Natural & Artificial. Types of Bonds: Vitrified, silicate, shellac, rubber, bakellite. Factors effecting the selection of grind wheels – size and shape of wheel – kind of abrasive – grain size – grade and strength of bond – structure of grain – spacing – kinds of bind material. Standard marking systems. Meaning of letters & numbers sequence of marking – Grades of letters. Grinding machines – classification: Cylindrical Grinding machine- construction details – relative merits. Principle of centreless grinding. Advantages & limitations of centreless grinding. Work- holding devices. Wheel maintenance – Balancing of wheels – Dressing and trimming of grind wheels: Coolants used.

Finishing by grinding: Honing, Lapping, Super finishing. Electroplating –. Hot dipping: Galvanizing, Tin coating, parkerising, Anodizing. Metal spraying: wire process, powder process and applications. Organic coatings: Oil base Paint, Lacquer base, Enamels, Bituminous paints, rubber base coating. Finishing specifications.

## 4.0. Jigs, Fixtures and Jig Boring.

Definition of jig - Types of jigs - leaf jig, box and handle jig, template jig, plate jig, Indexing jig, Universal jig, vice jigs. Explain the constructional details of the above jigs. General consideration in the design of drill jigs. Explain drill bush Types of fixtures: vice fixtures, milling fixtures, boring fixtures, grinding fixtures - Explain the constructional details of the above fixtures. Basic principles of location - Explain the locating methods and devices. Explain the basic principles of the clamping - Types of clamps - strap clamps, cam clamps, screw clamps, toggle clamps, hydraulic and pneumatic clamps.

Jig bring - Button boring on lathes- Jig boring on vertical milling machine. Types of jig boring machines - Open front machine - Cross rail type machine.Constructional details & their working - System of location of holes.

## 5.0 Modern Machining Processes

Introduction – comparison with traditional machining, Ultrasonic machining Principle – Description of equipment - applications. Electric Discharge Machining Principle – Description of equipment – Type of EDM Processes - applications.Abrasive jet machining - principle - description of equipment – applications.Laser beam machining - principle - description of equipment- applications.Chemical machining – Principle – description of equipment - Applications.

## REFERENCE BOOKS

1.    Manufacturing Technology    -    P N Rao (MGH Publishers)
2.    Production Technology    -    R.C.Patel
3.    Production Technology    -    Jain & Gupta.
4.    Gear Technology    -    Charrathi
5.    A Text Book of Production Engg    -    Dora
6.    Tool Design    -    Donaldson
7.    Manufacturing Technology    -    HajraChowdhary,Volume I & II
8.    Manufacturing Technology    -    P.N.Rao    Volume II

## Production DRAWING

| Course Title | Course Code | Periods/Week | Periods per Semester |
|---|---|---|---|
| Production Drawing | M-407 | 03 | 45 |

## TIME SCHEDULE

| Sl.No | Chapter/Unit Title | Periods | Weightage of Marks | | Short answer Questions | Essay type Questions |
|---|---|---|---|---|---|---|
| | | | PART A | PART B | | |
| 1 | Introduction to Production Drawing | 03 | - | | - | - |
| 2 | Limits, Fits & Dimensional Tolerances | 06 | 05 | 05 | 02 | - |
| | Geometrical Tolerances | 03 | 05 | 03 | | |
| | Surface finish | 03 | 05 | 03 | 01 | |
| 3 | Specification of materials and Standard Components | 03 | 05 | 04 | 01 | - |
| 4 | Preparation of Process sheet | 03 | | 05 | | - |
| 5 | Detailed and Part Drawings | 24 | | 20 | | 02 |
| Total | | 45 | **20** | **40** | **04** | **02** |

### Course objectives and Course Outcomes

| COURSE OBJECTIVES | Upon the completion of the course the student shall be able to |
|---|---|
| | 1. Familiarize with knowledge of the conventional representation of different materials and machine parts. |
| | 2. Familiarize with limits, fits, tolerances, surface treatment symbols adopted in the production drawings. |
| | 3 .Demonstrate the above skills in preparation of detailed drawings |

| COURSE OUTCOMES | At the end of the course students shall be able to: | |
|---|---|---|
| | CO1 | Use the conventions used in a production drawing |
| | CO2 | Use the specifications of material and geometrical tolerances |
| | CO3 | Specify the limits, fits and allocate tolerances for machine components |
| | CO4 | Apply concepts and methods in the preparation of production drawings |
| | CO5 | Convert machine drawings into production drawings |

**Model BLUE PRINT OF QUESTION PAPER**

| S. No | Chapter/Unit Title | Periods Allocated | Weightage Allocated | Marks Wise Distribution of Weightage | | | | Question Wise Distribution of Weightage | | | | CO's Mapped |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | R | U | Ap | An | R | U | Ap | An | |
| 1 | Introduction to Production Drawing | 02 | - | | | | | | | | | CO1 |
| 2 | Limits, Fits & Tolerances and Surface finish | 12 | 10 | | | 10 | | | | 02 | | CO2, CO3 |
| 3 | Specification of materials and standard components | 03 | 05 | | | 05 | | | | 01 | | C03 |
| 4 | Preparation of Process sheet | 03 | 05 | | | 05 | | | | 01 | | CO4 |
| 5 | Detailed and Part Drawings | 29 | 40 | | | 40 | | | | 02 | | CO1 to CO5 |
| | **Total** | 45 | 60 | | | **60** | | | | **06** | | |

R-Remember;     U-Understanding; Ap-Application ; An- Analylising

**Learning outcomes**

Upon completion of the course the student shall be able to

1**. 0    Introduction to Production Drawing**

  1.1 Differentiate between machine drawing and production drawing.

  1.2 Explain abbreviations for materials, draughting abbreviations

  1.3 State the factors that govern the preparation of a production drawing.

  1.4 Identify the components of a production drawing

**2.0   Limits, Fits &Tolerances and Surface Finish**

  2.1 State definition of limits, allowance, tolerance and fits.

  2.2 Select dimension from standards to give different type of fit for a given mating parts.

  2.3 Systems of fits-problems relating Hole basis and Shaft basis system and schematic diagrams- Select dimensions from B. I. S. Tables to obtain clearance, transition and interference fit for a given set of mating parts.

  2.4 Selection of fits and tolerances form B. I. S. tables.

2.4 Indicate fits on the drawings

2.5 Introduction and indication of form and position tolerances on drawings

2.6 Types of run-out, total run-out and their indication.

2.7 Explain Surface roughness terminology- surface roughness values, Grades and symbols.

2.8 Explain Symbols indicating surface texture

2.9 Surface roughness obtainable from various manufacturing processes, recommended surface roughness on mechanical components.Symbols representing direction of lay.

2.10 Heat treatment and surface treatment symbols used on drawings.

## 3.0 Specification of Materials

3.1 Identify the materials of various components

3.2 Specify the Raw materials as per Commercial/ BIS Standards

3.3 Identify the standard part that can be procured directly from the market and specify the part as per Commercial/ BIS Standards

## 4.0 Preparation of process sheet.

4.1    Indicate the sequence of process of production.

4.2    Specify the relevant tools to obtain the accuracy and finish.

4.3    Indicate the suitable equipment.

4.4    Specify the type of measuring instruments to be used to check the prescribed accuracy.9. Specification of standard components.

## 5.0 Detailed and part drawings

5.1 Interpretation of Drawings
5.2 Exercises in identifying the type of production, extracting important functional
       dimensions, checking the number of parts in an assembly. Checking and listing
       missing dimensions. Identifying the sectional views.
5.3 Prepare the relevant views of the parts of assembly drawing of Rigid Flange

Couplings.

5.4 Prepare the relevant views of the parts of assembly drawing of flexible

Flange Couplings.

5.5 Prepare the relevant views of the parts of assembly drawing of Universal

Coupling,

5.6 Prepare the relevant views of the parts of assembly drawing of Eccentric,

5.7 Prepare the relevant views of the parts of assembly drawing of Foot Step bearing,

5.8 Prepare the relevant views of the parts of assembly drawing of Stuffing box,

5.9 Prepare the relevant views of the parts of assembly drawing of Knuckle Joint,

5.10 Prepare the relevant views of the parts of assembly drawing of Plummer Block

5.11 Prepare the relevant views of the parts of assembly drawing of Screw jack

5.12 Prepare the relevant views of the parts of assembly drawing of revolving centre

5.13 Prepare the relevant views of the parts of assembly drawing of Drill Jig

**COURSE CONTENT**

**1.0 INTRODUCTION TO PRODUCTION DRAWING**

Drawing Sheet Sizes, Drawing sheet layout, Title block: 1.Title of the drawing, 2. Sheet number, 3. Scale (s), 4. Symbol, denoting the method of projection, 5. Name of the firm, and 6. Initials of the staff designed, drawn, checked and approved, Standard abbreviations: Draughting, material abbreviations, and shape identification symbols, Conventional representation of materials and machine components, method of indication notes on drawings, welding symbols.

**2.0 LIMITS FITS, TOLERANCES AND SURFACE FINISH**

State definition of limits, allowance, tolerance and fits, Select dimension from standards to give different type of fit for a given mating parts, Systems of fits-problems relating Hole basis and Shaft basis system and schematic diagrams-Select dimensions from B. I. S. Tables to obtain clearance, transition and interference fit for a given set of mating parts, Selection of fits and tolerances form B. I. S. tables, Indicate fits on the drawings. Definition of datum, datum feature, datum triangle, datum letter,  indication of  geometrical tolerance on the drawing, indication of  feature controlled,  indication of form and position tolerances on drawings, types of run-out, total run-out and their indication.

Explain Surface roughness terminology- surface roughness values, Grades and symbols, indicating surface texture, surface roughness obtainable from various manufacturing processes, recommended surface roughness on mechanical components. Symbols representing direction of lay. Heat treatment and surface treatment symbols used on drawings.

## 3.0 SPECIFICATIONS OF MATERIALS AND STANDARD COMPONENTS

Materials of the parts of the assembly-size of part, estimation of Raw material required for a component and specification. Standard components Parts like bolts, nuts, and Bearings etc.-specification of standard parts

## 4.0 PREPERATION OF PROCESS SHEET

Indicate the sequence of process of production; specify the relevant tools to obtain the accuracy and finish.
Indicate the suitable equipment; specify the type of measuring instruments to be used to check the prescribed accuracy, Specification of standard components.

## 5.0 DETAILED AND PART DRAWINGS

Interpretation of Drawings, Exercises in identifying the type of production, extracting important functional dimensions, checking the number of parts in an assembly. Checking and listing missing dimensions. Identifying the sectional views.

| Rigid Flange Coupling | Flexible Flange Coupling | Universal Coupling |
|---|---|---|
| Eccentric | Foot Step bearing | Stuffing box |
| Knuckle Joint | Plummer Block | Screw jack |
| Revolving Center | Drill Jig | Lathe Tool Post |

### REFERENCE BOOKS

IS 696 – 1972-Code of Practice for General Engg.  Drawing & B.I.S Code– SP. 46. IS 696– 1988- IS Code on fits and tolerances.
K.L. Narayana & P. Kannaiah, Production and Drawing, 3$^{rd}$ edition New Age international Publisher
R.K. Jain, Engineering Metrology, 2016 Khanna Publications

# COMMUNICATION SKILLS

| Course Code | Course Title | No. of Periods/Week | Total No. of Periods | Marks for FA | Marks for SA |
|---|---|---|---|---|---|
| M-408 | Communication Skills | 3 | 45 | 40 | 60 |

| S. No. | Chapter/Unit Title | No of Periods | COs Mapped |
|---|---|---|---|
| 1 | **Listening Skills** | 6 | CO1 |
| 2 | **Introducing Oneself** | 3 | CO1, CO2, CO3 |
| 3 | **Short Presentation (JAM)** | 6 | CO1, CO2, CO3 |
| 4 | **Group Discussion** | 6 | CO1, CO2, CO3 |
| 5 | **Preparing Resume with Cover Letter** | 3 | CO3 |
| 6 | **Interview Skills** | 9 | CO1, CO2, CO3 |
| 7 | **Presentation Skills** | 9 | CO1, CO2 |
| 8 | **Work place Etiquette** | 3 | CO1, CO2 |
| **Total Periods** | | **45** | |

| Course Objectives | To comprehend the features of communication needed for professional success and display the use of these competently |
|---|---|
| | To present ideas, opinions in group discussions and presentations on topics of general and technical interest |
| | To prepare for job selection processes |

| CO No. | Course Outcomes |
|---|---|
| CO1 | Interacts in academic and social situations by comprehending what is listened to when others speak. |
| CO2 | Demonstrates effective English communication skills while presenting ideas, opinions in group discussions and presentations on topics of general and technical interest. |
| CO3 | Exhibits workplace etiquette relevant in classroom situations for easy adaptation in professional setting in the future. |

**Blue Print for evaluation based on Course Outcomes for SA:**

**Note: Every Question based on CO has to be given marks for the following parameters of communication in the rubric.**

- Fluency and Coherence
- Lexical Resource (Vocabulary)
- Grammatical Range and Accuracy

**\*Rubric Descriptors 'Good/ Competent / Fair /Poor' for Communication**

| LEVEL OF COMPETENCE | Fluency and Coherence | Lexical Resource (Vocabulary) | Grammatical Range and Accuracy |
|---|---|---|---|
| **GOOD (9-10\*)** | Speaks at length without noticeable effort or loss of coherence. May demonstrate language-related hesitation at times, or some repetition and/or self-correction. | Uses vocabulary resources flexibly during discussion. Uses paraphrase effectively. | Uses a range of complex structures with some flexibility. |
| | Uses a range of connectives and discourse markers with some flexibility. **Articulates and adapts to near naturalization.** | Uses some less common vocabulary and shows some awareness of style and collocation | Mostly produces error-free sentences. |
| **COMPETENT (6-8)** | Is willing to speak at length, though may lose coherence at times due to occasional repetition, self-correction or hesitation. | Has enough vocabulary to discuss topics and make meaning clear in spite of inappropriacies. | Uses a mix of simple and complex structures, but with limited flexibility. |
| | Uses a range of connectives and discourse markers but not always appropriately | Generally paraphrases successfully | May make mistakes with complex structures though these rarely cause comprehension problems. |
| **FAIR (3-5)** | Tries to maintain a flow of speech but t uses repetition, self-correction and/or slow speech to keep going. | Manages to talk about familiar and unfamiliar topics but uses vocabulary with limited flexibility. | Produces only basic sentence forms, however, errors persist. |

| | | Produces simple speech fluently, but more complex communication causes fluency problems. | Attempts to use paraphrase but with mixed success. | Uses a limited range of more complex structures, but these usually contain errors and may cause some comprehension problems |
|---|---|---|---|---|
| **POOR (0 *-2)** | | Speaks with long pauses. Pauses lengthy before most words. **Merely imitates** | Uses simple vocabulary to convey personal information | Attempts basic sentence forms but with limited success, or relies on apparently memorized utterances |
| | | Has limited ability to link simple sentences | Has insufficient vocabulary for less familiar topics | Makes numerous errors except in memorized expressions |
| | | Gives only simple responses and is frequently unable to convey basic message | Only produces isolated words or memorized utterances | Struggles to produce basic sentence forms |

**s*10 marks to be awarded only if competence level shows flawless expertise in English.**
**\*0 marks to be awarded when student shows incoherence and gives irrelevant responses.**

**Blue Print for evaluation based on Course Outcomes for SA of each student:**
**Note:   Marks are awarded for each student as per the Rubric descriptors.**

| S. No. | Questions based on Course Outcomes | Periods Allocated for practical work | Marks Wise Distribution of Weightage | Marks allotment for each Student in the Rubric* | | | | Mapping of COs |
|---|---|---|---|---|---|---|---|---|
| | | | | Poor 0-2 | Fair 3-5 | Competent 6-8 | Good 9-10 | |
| 1 | Describe the given object in a minute | 6 | 10 | | | | | CO 2 |
| 2 | Exchange ideas/ views in a group discussion on _____ issue (academic, technical or social ) | 6 | 10 | | | | | CO1, CO 2 |

| S. No. | Questions based on Course Outcomes | Periods Allocated for practical work | Marks Wise Distribution of Weightage | | | | | Mapping of COs |
|---|---|---|---|---|---|---|---|---|
| 3 | Present your ideas /opinions on the given issue/Chapter(individual to an audience) | 9 | 10 | | | | | CO1, CO2, CO 3 |
| 4 | Role play an imaginary work-place situation | 6 | 10 | | | | | CO1, CO2, CO 3 |
| 5 | Individual interaction with the Examiner duly submitting Resume ( Facing the Interview) – Introducing oneself and answering questions | 12 | 10 | | | | | CO1, CO2, CO 3 |
| 6 | *Listen to and comprehend any audio communication/ content | 6 | 10 | | | | | CO1, CO2, CO 3 |
| | **TOTAL** | **45** | **60** | | | | | |

*__Listen to and comprehend the given audio content__: Giving the Students time to read the questions (Fill in the Blanks, Select from Alternatives, True or False, Table fill, etc.) in chunks before listening to audio inputs also played in chunks.

**Blue Print for evaluation based on Course Outcomes for Formative Assessment:**

**Note:  Every Question based on CO has to be given marks for the following parameters in the rubric.**

- Fluency and Coherence
- Lexical Resource
- Grammatical Range and Accuracy

| S. No. | Questions based on Course Outcomes | Periods Allocated for practical work | Marks Wise Distribution of Weightage | Marks allotment for each Student in the Rubric* | | | | Mapping of COs |
|---|---|---|---|---|---|---|---|---|
| | | | | Poor 0-2 | Fair 3-5 | Competent 6-8 | Good 9-10 | |
| **Formative Assessment - 1** | | | | | | | | |
| 1 | Describe the given object in a | 3 | 10 | | | | | CO 2 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | minute | | | | | | | |
| 2 | Exchange ideas/ views in a group discussion on _____ issue (academic, technical or social ) | 6 | 10 | | | | | CO1, CO 2 |
| 3 | Present your ideas /opinions on the given issue/Chapter(ind ividual to an audience) | 6 | 10 | | | | | CO1, CO2, CO 3 |
| 4 | *Listen to and comprehend any audio communication/ content | 3 | 10 | | | | | CO1, CO2, CO 3 |
| | **Total** | **18** | **40** | | | | | |
| Formative Assessment -2 | | | | | | | | |
| 1 | Present your ideas /opinions on the given issue/Chapter(ind ividual to an audience) | 3 | 10 | | | | | |
| 2 | Role play an imaginary work-place situation | 6 | 10 | | | | | CO1, CO2, CO 3 |
| 3 | Individual interaction with the Examiner duly submitting Resume ( Facing the Interview) – Introducing oneself and answering questions | 15 | 10 | | | | | CO1, CO2, CO 3 |
| 4 | *Listen to and comprehend any audio communication/ content | 3 | 10 | | | | | CO1, CO2, CO 3 |
| | **TOTAL** | **27** | **40** | | | | | |

**Learning Outcomes**

1. **Listening Skills:**
   1.1 Listen to audio content (dialogues, interactions, speeches, short presentations) and answer questions based on them
   1.2 Infer meanings of words / phrases / sentences / after listening to audio content as mentioned above

2. **Introducing Oneself:**
   2.1 Prepare a grid different aspects for presentation about a person / oneself
   2.2 Present a 1 or 2 minute introduction of oneself for an audience

3. **Short Presentation:**
   3.1 Define an object
   3.2 Describe an object, phenomenon, event, people
   3.3 Speak on a Chapter randomly chosen

4. **Group Discussion:**
   4.1 Practice Group Discussion. Techniques
   4.2 Participate in group discussions

5. **Resume Writing and Cover Letter:**
   5.1 Prepare resumes of different sorts – one's own and others.
   5.2 Write an effective cover letter that goes with a resume

6. **Interview Skills:**
   6.1 Prepare a good Curriculum Vitae
   6.2 Exhibit acceptable (Greeting, Thanking, Answering questions with confidence)

7. **Presentation Skills:**
   7.1 Prepare Posters, Charts, PPT's on issue of general and technical interest
   7.2 Present one's ideas before an audience with confidence using audio visual aids and answer questions that are raised.

8. **Workplace Etiquette:**
   8.1 Show positive attitude & adaptability / appropriate body language to suit the work place
   8.2 Display basic of etiquette like politeness, good manners.

## THERMAL ENGINEERING LAB PRACTICE

| Course Title | Course Code | Total No. of Periods | Total Periods Per Semester |
|---|---|---|---|
| Thermal Engineering Lab Practice | M – 409 | 03 | 45 |

### TIME SCHEDULE

| S. No. | EXERCISE TITLE | Periods |
|---|---|---|
| 1. | Economic Speed Test on S.I and C.I engines | 09 |
| 2. | Morse Test | 06 |
| 3. | Performance tests on S.I and C.I engines | 09 |
| 4. | Heat Balance Sheet | 09 |
| 5. | Valve timing diagram and Port timing diagram | 06 |
| 6. | Performance of Air compressor | 06 |
| **Total No. Periods** | | **45** |

### Course Objectives and Course Outcomes

| | | | Upon completion of the course the student shall be able to: |
|---|---|---|---|
| **Course Objectives** | | | Upon completion of the course the student shall be able to:<br>(i) To familiarise with the knowledge of materials and tools used in conducting performance tests on I C Engines and on Air compressors.<br>(ii) To reinforce the concepts economic speed, heat balance, valve timing and port timing diagrams by conducting corresponding experiments |
| **Course Outcomes** | | | Upon completion of the course the student shall be able to: |
| | CO1 | M 409-1 | Conduct the tests to determine the performance of I C Engines using given apparatus. |
| | CO2 | M 409-2 | Conduct the tests to determine the performance of Air compressors. |
| | CO3 | M 409-3 | Perform precise operations with I C Engines and Air Compressors. |
| | CO4 | M 409-4 | Analyse the experimental results to draw inferences, to make recommendations |
| | CO5 | M 409-5 | Use ethics and etiquette while working in a group and display professionalism while communicating as a member and a leader in a group. |

### Learning Outcomes
Upon on completion of the course the student shall be able to:

**1.0 Conduct an experiment to determine the economical speed test on given I C Engine**
  1.1 Apply lubricant between the mating parts of the engine
  1.2 Check the fuel oil supply line
  1.3 Place the thermometers at required positions

1.4 Circulating the cooling water through the engine jacket before starting engine and after shutting down the engine
1.5 Start the engine using decompression lever
1.6 Run the engine for a certain period of time before loading
1.7 Measure speed of the engine with tachometer
1.8 Adjust spark timing in case of SI engine
1.9 Adjust the throttle valve to control the fuel supply in case of CI engine
1.10 Apply the loads
1.11 Record brake load, speed of rotation (RPM) at different loads and the rate of fuel consumption
1.12 Remove the load

**2.0 Conduct an experiment to find the performance on a multi cylinder engine**

2.1 Apply lubricant between the mating parts of the engine
2.2 Check the fuel oil supply line
2.3 Place the thermometers at required positions
2.4 Circulating the cooling water through the engine jacket before starting engine and after shutting down the engine
2.5 Start the engine using decompression lever
2.6 Run the engine for a certain period of time before loading
2.7 Measure speed of the engine with tachometer
2.8 Apply the load
2.9 Record brake load, speed of rotation (RPM), the rate of fuel consumption
2.10 Cut off the first cylinder
2.11 Record brake load, speed of rotation (RPM), the rate of fuel consumption
2.12 Repeat the above act for all the cylinders

**3.0 Conduct an experiment to determine the performance parameters**

3.1 Apply lubricant between the mating parts of the engine
3.2 Check the fuel oil supply line
3.3 Place the thermometers at required positions
3.4 Circulating the cooling water through the engine jacket before starting engine and after shutting down the engine
3.5 Start the engine using decompression lever
3.6 Run the engine for a certain period of time before loading
3.7 Measure speed of the engine with tachometer
3.8 Adjust spark timing in case of SI engine
3.9 Adjust the throttle valve to control the fuel supply in case of CI engine
3.10 Apply the load
3.11 Record brake load, speed of rotation (RPM) and the rate of fuel consumption
3.12 Remove the load

**4.0 Conduct an experiment to draw the heat balance sheet for given I C Engine**

4.1 Apply lubricant between the mating parts of the engine
4.2 Check the fuel oil supply line
4.3 Place the thermometers at required positions

4.4     Circulating the cooling water through the engine jacket before starting engine and after shutting down the engine

4.5     Start the engine using decompression lever

4.6     Run the engine for a certain period of time before loading

4.7     Measure speed of the engine with tachometer

4.8     Adjust spark timing in case of SI engine

4.9     Adjust the throttle valve to control the fuel supply in case of CI engine

4.10     Apply the load

4.11     Record brake load, speed of rotation (RPM), the rate of fuel consumption, the rate of flow of cooling water and water inlet and outlet temperatures of engine jacket

4.12     Record exhaust gas temperature at calorimeter outlet

## 5.0     Conduct an experiment to draw the valve and port timing diagrams

5.1     Place the spirit level, metal tape and piece of chalk near the engine

5.2     Erase the previous chalk marks on the flywheel

5.3     Apply lubricate in the piston and valve mechanism

5.4     Fix the graduated disc to the crank shaft

5.5     Adjust the pointer to zero position of graduated disc

5.6     Mark the TDC and BDC on the disc using the spirit level

5.7     Mark the operations (Suction, Compression, Ignition, Expansion and Exhaust)

5.8     Measure the circumference of flywheel

5.9     Locate exact position of inlet valve/port opening and inlet valve/port closing by inserting feeler gauge between inlet roller and cam

5.10     Find exact position of Ignition starting and ignition tripping

5.11     Locate exact position of exhaust valve/port opening and exhaust valve/ port closing by inserting feeler gauge between inlet roller and cam

5.12     Measure the circumferential distances between the valve/port opening, closing, ignition starting and ignition tripping with respect to the TDC and BDC

## 6.0     Conduct an experiment to Performance of Air compressor

6.1     Check the lubricating oil level in the crank case

6.2     Opening and closing of storage outlet valve

6.3     Checking orifice and its diaphragm condition

6.4     Fill water in U-tube manometer

6.5     Check function and usage of tachometer

6.6     Check function and usage of stop watch

6.7     Record time taken for 10 revolutions of energy meter disc

6.8     Record compressor speed (RPM) using tachometer

6.9     Record manometer readings

6.10     Record pressure gauge reading

# HYDRAULICS & FLUID POWER SYSTEMS LAB PRACTICE

| Course Title | Course Code | Periods/Week | Periods/Semester |
|---|---|---|---|
| HYDRAULICS & FLUID POWER SYSTEMS LAB PRACTICE | M-410 | 03 | 45 |

## TIME SCHEDULE

| S. No | EXERCISE TITLE | Periods allocated |
|---|---|---|
| 1 | Verification Of Bernoulli's Theorem | 06 |
| 2 | Determination of Coefficient of Discharge of Venturi Meter | 03 |
| 3 | Determination Of Friction Factor For A Given Pipe Line | 03 |
| 4 | Performance Test On Pelton Wheel | 03 |
| 5 | Performance Test On Francis Turbine | 06 |
| 6 | Performance Test On Kaplan Turbine | 06 |
| 7 | Performance Test On Centrifugal Pump | 06 |
| 8 | Performance Test On Reciprocating Pump | 06 |
| 9 | Demonstration of Hydraulic Circuits | 03 |
| 10 | Demonstration of Pneumatic Circuits | 03 |
| **Total** | | **45** |

## Course Objectives and Course Outcomes

| COURSE OBJECTIVES | Upon completion of the course the student shall be able to |
|---|---|
| | Familiarize with knowledge in verification of principles of fluid flow |
| | Use skills in measuring pressure, discharge and velocity of fluid flow |
| | reinforce theoretical concepts by conducting experiments for Major and Minor Losses |
| | reinforce theoretical concepts by conducting experiments in performance testing of Hydraulic Turbines and Hydraulic Pumps |
| | Familiarize with the main components of the hydraulic and pneumatic systems and design, draw circuits and conduct experiments hydraulic and pneumatic circuits for a given problem. |
| **COURSE OUTCOMES** | CO1 | Perform experiments to determine the coefficient of discharge of Venturi meter. |
| | C02 | Demonstrate the experiments to determine the co-efficient of friction of flow in a pipe and minor losses in pipe joints |
| | C03 | Demonstrate the experiments on hydraulic turbines to draw characteristic curves |
| | C04 | Demonstrate the experiments on pumps to draw characteristic curves |
| | C05 | Identify the common hydraulic and pneumatic components, their uses and symbols |

**Learning outcomes**

Upon the completion of the course the student shall be able to

**1.0  Verification Of Bernoulli's Theorem**
      1.1 State Bernoulli's  theorem
      1.2  Identify the apparatus required
      1.3  Explain the Test procedure to verify Bernoulli's experiment.

**2.0 Determination of  $C_d$  of Venturimeter**
      2.1 State the practical applications of venturimeter.
      2.2 Record the manometric head readings from U-tube manometer
      2.3 Record the time taken for collecting discharge by varying the discharge
      2.4 Calculate the areas of the pipe and throat of the given venturimeter
      2.5 Calculate coefficient of discharge of venturimeter.

**3.0 Determination of loss of head due to friction in a given pipe**
      3.1 Measure the length of the given pipe
      3.2 Record the pressure head readings from U-tube manometer
      3.3 Record the time taken for collecting discharge by varying the discharge
      3.4 Calculate the loss of head through the pipe
      3.5 Calculate the friction factor

**4.0 Determination of Power and Efficiency of Pelton Wheel**
      4.1 Identify the components of Pelton wheel
      4.2 Start turbine by switching on jet of water slowly
      4.3 Apply load steadily
      4.4 Record load, speed
      4.5 Calculate brake power and efficiency of turbine

**5.0 Determination of Power and Efficiency of Kaplan Turbine**
      5.1Identify the components of Kaplan Turbine
      5.2 Start turbine by giving input water supply
      5.3 Apply load steadily
      5.4 Record load, speed
      5.5 Calculate power and efficiency of turbine

**6.0 Determination of Power and Efficiency of Francis Turbine**
      6.1 Identify the components of Francis Turbine
      6.2 Start turbine by switching on jet of water slowly
      6.3 Apply load steadily
      6.4 Record load, speed
      6.5 Calculate power and efficiency of turbine

**7.0 Determination of Power required and Efficiency of Centrifugal Pump**
      7.1 Identify the components of centrifugal pump
      7.2 Record the suction and delivery pressures from pressure gauges
      7.3 Record the time taken for collecting the discharge
      7.4 Record the energy meter readings and calculate input power
      7.5 Calculate the power input
      7.6 Calculate the efficiency

**8.0 Determination of of Power required and Efficiency of Reciprocating Pump**

       8.1 Identify the components of reciprocating pump

       8.2 Record the suction and delivery pressures from pressure gauges

       8.3 Record the time taken for collecting the discharge

       8.4 Record the energy meter readings and calculate input power

       8.5 Calculate the  power input

       8.6 Calculate the efficiency

**9.0 Identification of Hydraulic circuits**

       9.1  Explain Hydraulic Circuit

       9.2 Identify & List Symbols used in Hydraulic circuits.

       9.3  List all the hydraulicapplications.

       9.4  Classify the actuators.

       9.5  List different types of valves.

       9.6  Explain the function of a valve.

       9.7  Identify the components of a valve.

       9.8  Identify about ports and positions.

       9.9  List the Applications of valves.

**10.0 Identification of Pneumatic Circuits**

       10.1      Explain Pneumatic Circuit

       10.2      Identify & List Symbols used in Pneumatic circuits.

       10.3      Explain the phenomena of compressed air for transmitting power.

       10.4      List all the pneumatic applications.

       10.5      Define  Pneumatic actuator.

       10.6      Classify the actuators.

       10.7    Explain Linear actuators and Rotary actuators.

       10.8      List different types of valves.

       10.9      Explain the function of a valve.

       10.10    Identify the components of a valve.

       10.11    Identify about ports and positions.

       10.12     List the Applications of valves.

**COURSE CONTENT**

1.     VERIFICATION OF BERNOULLI'S THEOREM

**2.**     DETERMINATION OF FRICTION FACTOR FOR A GIVEN PIPE LINE

3.     VENTURIMETER

4.     PERFORMANCE TEST ON PELTON WHEEL

5.     PERFORMANCE TEST ON FRANCIES TURBINE

6.     PERFORMANCE TEST ON KAPLAN TURBINE

7.     PERFORMANCE TEST ON CENTRIFUGAL PUMP

8.     PERFORMANCE TEST ON RECIPROCATING PUMP

9.     HYDRAULIC CIRCUIT

10.    PNEUMATIC CIRCUIT

# Workshop Practice-II

| Course Title | Course Code | Periods/Week | Periods per Semester |
|---|---|---|---|
| Workshop Practice-II | M-411 | 03 | 45 |

| Course Objectives | | Upon the completion of the course the student shall able<br>• To Familiarize Milling Machine<br>• To handle milling, Slotting, Grinding and Welding Operations safely<br>• To reinforce theoretical concepts by practising relevant exercises of Milling, slotting, Grinding and Welding Operations<br>• Obtain skill in Milling, slotting, Grinding, Shaping and Welding Operations | |
|---|---|---|---|
| **Course Outcomes** | CO1 | M-411.1 | Operate Milling machine to perform various operations. |
| | CO2 | M-411.2 | Operate Slotter & shaper to perform various operations. |
| | CO3 | M-411.3 | Operate Grinding Machine to perform various operations. |
| | CO4 | M-411.4 | Fabricate the useful objects by welding. |

## TIME SCHEDULE

| S.NO | EXERCISE TITLE | NO.OF PERIODS |
|---|---|---|
| 1 | Hands on practice on Milling Machine<br>T-Slot cutting<br>Spur Gear Cutting<br>Helical Gear Cutting | 9 |
| 2 | Hands on practice on Slotting Machine<br>Keyway Cutting | 9 |
| 3 | Hands on practice on shaper<br>Keyway Cutting | 9 |
| 4 | Hands on practice on Surface Grinding Machine<br>Preparation of Rectangular Block | 9 |
| 5 | Hands on practice on Arc Welding Machine<br>Fabrication of Window Grill<br>Fabrication of Stool | 9 |
| TOTAL | | 45 |

**Learning Outcomes:**
Upon completion of the course the student shall be able

**Perform T-slot cutting on milling machine**
    1.1 Select proper tool to perform the job
    1.2 Set the Job on Machine
    1.3 Select the speed for milling operation
    1.4 Practice T-slot cutting operation on a milling machine
    1.5 Use measuring instruments for checking dimensions.

**Perform Spur gear cutting on milling machine**

    2.1 Select milling cutter to perform the job

    2.2 Set the Job on Machine

    2.3 Index the job

    2.4 Select the speed for gear cutting operation

    2.5 Practice gear cutting operation on a milling machine

    2.6 Use measuring instruments for checking dimensions

**Perform helical gear cutting on milling machine**

    3.1 Select milling cutter to perform the job

    3.2 Set the Job on Machine

    3.3 Index the job

    3.4 Select the speed for helical gear cutting operation

    3.5 Practice helical gear cutting operation on a milling machine

    3.6 Use measuring instruments for checking dimensions

**Perform keyway cutting on slotting machine**

    4.1 Select cutter to perform the job

    4.2 Set the Job on Machine

    4.3 Select the speed for Slotting operation

    4.4 Practice slotting operation on a slotting

    4.5 Use measuring instruments for checking dimensions

**Perform surface grinding on rectangular block**

    5.1 Identify the functional application of different levers, stoppers, adjustments on surface grinding machine.

    5.2 Identify different lubrication points of surface grinder

    5.3 Identify lubricants and their usage for application in surface grinder

    5.4 5 Identify different work and tool holding devices and acquaint with functional application of each device

5.5 Mount the work and tool holding devices with required alignment and check for its functional usage to perform the surface grinding operations on a rectangular block.

5.6 Observe safety procedure during mounting as per standard norms

**Perform keyway cutting on shaping machine**

6.1 Select cutter to perform the job

6.2 Set the Job on Machine

6.3 Select the speed for Shaping operation

6.4 Practice key way cutting on a shaper

6.5 Use measuring instruments for checking dimensions

**Fabrication of Iron Window Grill by arc welding method**

7.1 Plan and select the type & size of electrode, welding current.

7.2 Prepare edge as per requirement

7.3 Prepare, set arc welding machine as per sketch.

7.4 Deposit the weld maintaining appropriate arc length, electrode angle, welding speed, weaving technique and safety aspects.

7.5 Clean the welded joint thoroughly.

7.6 Carry out visual inspection for appropriate weld joint

**Fabrication of stool frame by arc welding method**

8.1 Prepare the angle iron pieces as per drawing

8.2 Plan the sequence of steps

8.3 Plan and select the type & size of electrode, welding current.

8.4 Prepare edge as per requirement

8.5 Prepare, set arc welding machine as per sketch.

8.6 Deposit the weld maintaining appropriate arc length, electrode angle, welding speed, weaving technique and safety aspects.

8.7 Clean the welded joint thoroughly.

8.8 Carry out visual inspection for appropriate weld joint

**REFERENCE BOOKS**

1.    A text book of welding Technology –Khanna O.P. DhanpathRai Publications

2.    Workshop practice –Swarna Singh

3.    Elements Of Workshop Technology - Volume II - Machine Tools, Media Promoters Pvt, Ltd

# V SEMESTER

# DIPLOMA IN MECHANICAL ENGINEERING
## SCHEME OF INSTRUCTIONS AND EXAMINATIONS
### V Semester

| Course Code | Course Title | Instruction period / week | | Total Period / year | Scheme of Examination | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Practical / Tutorial | | Duration (hours) | Sessional Marks | End Exam Marks | Total Marks |
| THEORY | | | | | | | | |
| M-501 | Industrial Management and Entrepreneurship | 5 | - | 75 | 3 | 20 | 80 | 100 |
| M-502 | Industrial Engineering and Estimation & Costing | 5 | - | 75 | 3 | 20 | 80 | 100 |
| M-503 | Theory of Machines | 4 | - | 60 | 3 | 20 | 80 | 100 |
| M-504 | Heat Power Engineering-II | 4 | - | 60 | 3 | 20 | 80 | 100 |
| M-505 | Refrigeration and Air Conditioning | 5 | - | 75 | 3 | 20 | 80 | 100 |
| M-506 | Computer Aided Manufacturing Systems | 4 | - | 60 | 3 | 20 | 80 | 100 |
| PRACTICAL | | | | | | | | |
| M-507 | 507-A CAD Lab Practice<br>507-B CAM Lab Practice | - | 3+3 | 45+45 | 3 | 20<br>20 | 30<br>30 | 100 |
| M-508 | Life skills Lab Practice | - | 3 | 45 | 3 | 40 | 60 | 100 |
| M-509 | R&AC Lab Practice | - | 3 | 45 | 3 | 40 | 60 | 100 |
| M-510 | Project Work | - | 3 | 45 | 3 | 40 | 60 | |
| *TOTAL* | | 27 | 15 | 630 | | 280 | 720 | 1000 |

**Note: All the students should appear for both 507-A and 507-B examinations.
Separate external examiners shall be appointed**

## Industrial Management and Entrepreneurship

| Course Title | Course Code | Periods/Week | Periods per Semester |
|---|---|---|---|
| Industrial Management and Entrepreneurship | M-501 | 05 | 75 |

## TIME SCHEDULE

| Sl. No. | Chapter/Unit Title | Periods | Weightage of Marks | Short Answer Questions (3M) | Essay Type Questions (8M) | Higher Order Question (10M) |
|---|---|---|---|---|---|---|
| 1. | Basics of Industrial Management. | 06 | 03 | 01 | | |
| 2 | Organisation structure & Organisational behaviour | 15 | 11 | 01 | 01 | 01 |
| 3 | Production Management | 10 | 11 | 01 | 01 | |
| | Materials Management | 10 | 14 | 02 | 01 | |
| | Maintenance Management & Industrial Safety | 10 | 11 | 01 | 01 | |
| 4 | Entrepreneurship Development | 12 | 11 | 01 | 01 | |
| 5 | New Trends in Management | 12 | 09 | 03 | | |
| **Total** | | **75** | **70+10** | **10** | **05** | **01** |

**Note: 10 Marks higher order question may be given from the Chapter -2 or Chapter - 3**

## Course Objectives and Course Outcomes

<table>
<tr><td rowspan="3"><strong>COURSEOBJECTIVES</strong></td><td colspan="3">Upon completion of the course the student shall be able to</td></tr>
<tr><td>(i)</td><td colspan="2">Familiarise the concepts of management, ownership styles and organisation structures.</td></tr>
<tr><td>(ii)<br>(iii)</td><td colspan="2">Exposure to organisational behavioural concepts, basics of project and operational management and materials management in industries.<br>Understand the modern trends of management in industries.</td></tr>
<tr><td rowspan="5"><strong>COURSE OUT COMES</strong></td><td>CO1</td><td>M-501.1</td><td>Understand the principles of management as applied to industry</td></tr>
<tr><td>C02</td><td>M-501.2</td><td>Explain types of ownerships, the organisation structure of different business organisations and the behaviour of an individual in an organisation, motivational and leadership models</td></tr>
<tr><td>C03</td><td>M-501.3</td><td>Explain the different aspects of production management, Materials Management and Maintenance activities in industries.</td></tr>
<tr><td>CO4</td><td>M-501.4</td><td>Describe the role of entrepreneur in economic development</td></tr>
<tr><td>CO5</td><td>M-501.5</td><td>Explain the latest trends and technologies which are essential for the overall progress of Entrepreneur.</td></tr>
</table>

## Model Blue Print of the Question Paper

| S. No | Chapter/Unit Title | Periods Allocated | Weightage Allocated | Marks Wise Distribution of Weightage | | | | Question Wise Distribution of Weightage | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | R | U | Ap | An | R | U | Ap | An |
| 1 | Basics of Industrial Management | 06 | 03 | 03 | | | | 01 | | | |
| 2 | Organisation Structure & Organisational Behaviour | 15 | 21 | 03 | | 08 | 10 | 01 | | 01 | 01 |
| 3 | Production Management | 10 | 11 | 03 | | 08 | | 01 | | 01 | |
| | Materials Management | 10 | 14 | 06 | | 08 | | 02 | | 01 | |
| | Maintenance Management & Industrial Safety | 10 | 11 | 03 | | 08 | | 01 | | 01 | |
| 4 | Entrepreneurship Development | 12 | 11 | 03 | | 08 | | 01 | | 01 | |

| 5 | New Trends in Management | 12 | 09 | 09 | | | | 03 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Total** | **75** | 80 | **30** | | **40** | **10** | **10** | | **05** | **01** |

R-Remembering;    U-Understanding;    Ap-Applying;    An- Analylising
**Note:  10 Marks higher order question may be given from the Chapter- 2 or Chapter -3 ( Here it is taken from Chapter – 2)**

**Learning Outcomes**
*Understand the principles of management as applied to industry.*

**1.0 Basics of Industrial Management**
1.1 Define industry, commerce (Trade) and business.
1.2 Know the need for management.
1.3 Understand functions of Management.
1.4 List the principles of scientific management by F.W.Taylor
1.5 List the principles of management by Henry Foyal.
1.6 Differentiate management, administration and organisation
1.7 Differentiate lower, middle and Top level management
1.8 Explain the importance of managerial skills (Technical, Human, Conceptual)

**2.0 Organisation Structure & Organisational Behaviour**
2.1 Know types of ownerships, the organisation structure of an industry and the behaviour of an individual in an organisation.
2.2 Understand the philosophy and need of organisation structure of an industry.
2.3 Understand the line, staff and line &staff organisations
2.4 Outline the communication process
2.5 State
     a.  Motivation theories.
     b.  Explain Maslow's Hierarchy of needs.
2.6 Explain
     a. Different leadership models
     b. Trait theory of leadership
     c. Behavioural theory of Leadership
     d. The process of decision making.
2.7 Assessing Human resource requirements
2.8 Understand
    a. the process of recruitment, selection, training and development
    b. types of business ownerships

**3.(a)Production Management**
3.1 Understand the different aspects of production management.
3.2 Identify the factors of Plant Location
3.3 Know the objectives of plant Layout

3.4 Understand the principles of plant Layouts

3.5 Explain the types of plant Layouts

3.6 Relate the production department with other departments.

3.7 Explain

    (a)Function of Production, planning and control.

    (b) Break Even Analysis

3.8 Draw PERT/CPM networks.

**3(b) Materials Management**

3.9.   Understand the role of materials management industries.

3.10. Explain the importance of materials management in Industry.

3.11. Know the functions of Materials Management

3.12. Explain ABC analysis.

3.13. Define (a) Safety stock. (b) Reorder level

3.14. Derive an expression for economic ordering quantity.

3.15. Know the functions of Stores Management, types of store layouts, stores records

3.16. Describe the Bin card, Cardex method

3.17. Explain

    (a) General purchasing procedures

    (b) Tendering, E-tendering and E-procurement procedures

    (c) Purchase records.

**3(c) Maintenance Management & Industrial Safety**

3.18. Comprehend the Importance of Maintenance Management & Safety procedures

3.19. Explain the importance of maintenance management in Industry.

3.20.  Know the

    (a)Objectives of maintenance management

    (b)Activities of maintenance management

    (c)Importance of Preventive maintenance

    (d) Need for scheduled maintenance

3.21. Differentiate scheduled and preventive maintenance

3.22. Know the principles of 5 s for good house keeping

3.23.Explain

    (a)  The importance of safety at Work place.

    (b) The important provisions related to safety.

    (c) Hazard and accident.

    (d) Different hazards in the industry.

    (e) The causes of accidents, prevention

3.24. Explain the direct and indirect cost of accidents.

**4. Entrepreneurship Development.**

4.1. Understand the role of entrepreneur in economic development and in improving the quality of life.

4.2. Define the word entrepreneur.

4.3. Explain

(a) The requirements of an entrepreneur.

(b) The role of entrepreneurs in promoting Small Scale Industries.

4.4. Describe

(a)  The details of self-employment schemes.

(b) Characteristic of successful entrepreneurs

4.5. Explain the method of site selection.

4.6. List out

(a) the financial assistance programmes for entrepreneurial development

(b) the organisations that help an entrepreneur

4.7. Know the use of  EDP Programmes

4.8. Understand

(a) the concept of make in India, Zero defect and zero effect

(b) the importance for start-ups

(c)  the conduct of demand surveys

(d) the conduct of a market survey

(e)Evaluation of Economic and Technical factors.

4.9. Prepare feasibility report study


## 5. New Trends in Management

5.1. Understand the new concepts adopted in modern management

5.2. Know the differences between data and information

5.3. Understand the information as a resource

5.4. Explain

(a)  the use of Information technology in the organizational functions

(b)   the applications of RFID

(c)  the concept of quality.

(d) the quality systems and elements of quality systems.

(e) the principles of quality Assurance.

(f) the basic concepts of TQM

5.5. Know the Pillars of TQM

5.6. List the

(a) ISO standards.

(b) Beneficiaries of ISO 9000.

5.7. Explain

(a) ISO standards and ISO 9000 series of quality systems.

(b) the concepts of  ISO 14000

**Smart Technologies**

       5.8. Get an overview of IoT

       5.9. Define the term IoT

       5.10. Know how IoT work

       5.11. List the key features of IoT

       5.12. List the components of IoT : hardware, software, technology and protocols

       5.13. List the advantages and disadvantages of IoT

       5.14. List the applications of IOT

**Course Content**

**1.0 Basics of Industrial Management**

       Introduction: Industry, Commerce and Trade; Definition of management; Functions of management; Principles of scientific management: – F.W.Taylor, Principles of Management: Henry Fayol; Administration organisation and management; Nature of management; levels of management; managerial skills;

**2.0 Organisation Structure & Organisational Behaviour**

       Organizing - Process of Organizing; Line, Staff and line & staff Organizations, Communication, Motivational Theories; Leadership Models; Decision making, Human resources development; Forms of Business ownerships: Types – Sole proprietorship, Partnership, Joint Stock Companies, Cooperative types of Organizations, Corporations, Boards.

**3. (a)Production Management**

       Definition and importance; Plant location and layout; Types of production -job, batch and mass; production Planning and Control: relation of production department with other departments, routing, scheduling, dispatching and follow up; Break even analysis; Application of CPM and PERT techniques; simple numerical problems;

**3.(b) Materials Management**

       Materials in industry, Basic inventory control model, ABC Analysis, Safety stock, re-order level, Economic ordering quantity, Stores Management: Stores layout, stores equipment, Stores records, purchasing procedures, e-tendering, e-procurement; purchase records, Bin card, Cardex system.

**3.(c)Maintenance Management & Industrial Safety**

       Objectives and importance of plant maintenance, Different types of maintenance, Nature of maintenance problems, Range of maintenance activities, Schedules of preventive maintenance, Advantages of preventive maintenance,5 S principles; Importance of Safety at work places; Causes of accidents-cost of accidents-prevention- industrial hazards

**4. Entrepreneurship Development**

Definition of Entrepreneur; Role of Entrepreneur; Concept of Make In India, ZERO defect, Zero Effect, Concept of Start-up Company, Entrepreneurial Development: Role of SSI, MSME, DICs, Entrepreneurial development schemes; Institutional support, financial assistance programmes; Self-employment schemes, Market survey and Demand survey; Preparation of Feasibility study reports

**5.0 New Trends in Management**

Introduction to Management Information System (MIS); RFID application in materials management; Total Quality Management (TQM)- Concept of quality discussed by B. Crosby W. Edward, Deming, Joseph M. Juran, Kooru Ishikawa, Genichi Taguchi, Shigco Shingo. Quality systems – Definitions of the terms used in quality systems like, quality policy, quality management, quality systems, Stages of development of ISO9000 series , ISO-14000,

**Smart Technologies** : Over view of IoT - Define IoT, how IoT work, key features of IoT, components of IoT : hardware, software, technology and protocols, advantages and disadvantages of IoT –Applications of IoT-Smart Manufacturing.

**REFERENCE BOOKS**

1.Industrial Engineering and Management        -by O.P Khanna
2. Production Management- by Buffa.
3. Engineering Economics and Management Science - by Banga & Sharma.
4. Personnel Management by Flippo.
5. Production and Operations Management –S.N. Chary
6. Converging_Technologies for Smart Environments and Integrated Ecosystems IERC Book Open Access 2013 pages-54-76

# INDUSTRIAL ENGINEERING AND ESTIMATION & COSTING

| Course Title | Course Code | Periods/Week | Periods per Semester |
|---|---|---|---|
| Industrial Engineering and Estimation & Costing | M-502 | 05 | 75 |

## TIME SCHEDULE

| S. No. | Chapter/Unit Title | Periods | Weightage of Marks | Short Answer Questions (3M) | Essay Type Questions (8M) | Higher Order Question (10M) |
|---|---|---|---|---|---|---|
| 1 | Work Study | 15 | 14 | 2 | 1 | * |
| 2 | Statistical Quality Control (SQC) | 15 | 14 | 2 | 1 | |
| 3 | Fundamentals of Estimation and Costing. | 15 | 14 | 2 | 1 | |
| 4 | Estimation of Weights and Machining Times. | 15 | 14 | 2 | 1 | * |
| 5 | Estimation of Forging and Welding Costs. | 15 | 14 | 2 | 1 | * |
| | Total | 75 | 70+10 | 10 | 05 | 01 |

**Note: * 10 marks higher order question may be given from Chapter-1 or Chapter -4 or Chapter -5**

## Course Objectives and Course Outcomes

| | | | Upon completion of the course the student shall be able to |
|---|---|---|---|
| **Course Objectives** | | | • Contribute to improving efficiency, productivity and/or quality of products manufactured or services provided in the organizations.<br>• Address the underlying concepts, methods and application of Engineering Costing & Estimating |
| **Course Out Comes** | CO1 | M-502.1 | Explain principle of work study and contribution of work study to productivity and wage systems. |
| | CO2 | M-502.2 | Differentiate various inspection methods.<br>Illustrate various statistical quality control methods. |
| | CO3 | M-502.3 | Explain how to estimate the cost of a manufactured product. |
| | CO4 | M-502.4 | Estimate weight of material and machining times for a product to be manufactured or machined. |
| | CO5 | M-502.5 | Estimation the cost of a product manufactured or fabricated by using Forging and Welding Techniques. |

**Model Blue Print of the Question Paper**

| S. No | Chapter /Unit Title | Periods Allocated | Weightage of Marks | Marks Wise Distribution of Weightage | | | | Question Wise Distribution of Weightage | | | | CO's Mapped |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | R | U | Ap | An | R | U | Ap | An | |
| 1 | Work Study | 15 | 14 | 03 | 03 | 08 | 10 | 01 | 01 | 01 | 01 | CO1 |
| 2 | Statistical Quality Control (SQC) | 15 | 14 | 03 | 03 | 08 | | 01 | 01 | 01 | | CO2 |
| 3 | Fundamentals of Estimation and Costing | 15 | 14 | 03 | 03 | 08 | - | 01 | 01 | 01 | - | CO3 |
| 4 | Estimation of Weights and Machining Times | 15 | 14 | 03 | 03 | 08 | - | 01 | 01 | 01 | - | CO4 |
| 5 | Estimation of Forging and Welding Costs. | 15 | 14 | 03 | 03 | 08 | - | 01 | 01 | 01 | - | CO5 |
| | **Total** | **75** | **70+10** | **15** | **15** | **40** | **10** | **05** | **05** | **05** | **01** | |

R-Remembering;     U-Understanding;     Ap-Applying;     An- Analylising
**Note: * 10 marks higher order question may be given from Chapter-1  or Chapter -4 or Chapter -5. ( Here it is taken from the Chapter- 1)**

**Learning Outcomes**
Upon completion of the course the student shall be able to

**1.0.   Work Study**
  1.1.  Define Production, Productivity, Work study, Method Study and Work Measurement
  1.2.  State objectives and applications of Work study, Method Study and Work Measurement
  1.3.  Explain the Steps: Define, Record, Critical Examination, Develop, Install and maintain for conduct of method study to increase the productivity.
  1.4.  Explain process chart symbols with examples.
  1.5.  Explain the use of flow diagram and string diagram and chrono-cycle graph.
  1.6.  Identify various therbligs used in the micro-motion study.
  1.7.  Explain the use of therbligs with a SIMO chart.
  1.8.  Explain Time study Procedure by using a stop watch.
  1.9.  Compute the standard time for an operation by adding its constituent elements.
  1.10. Explain the procedure of Predetermined Motion Time Standards ( PMTS)

1.11. Explain the method of conducting work sampling.
1.12. State the terms involved in wage systems.
1.13. State different incentive plans.
1.14. Solve simple problems on Halsey, Rowan and Emerson efficiency plans.

## 2.0    Statistical Quality Control (SQC).
2.1. State the different inspection methods.
2.2. Explain briefly different methods of inspection with advantages and limitations.
2.2. Define the concept of the term Quality and Quality control.
2.4  Explain the need of Statistical Quality Control of the products
2.5. List basic quality control tools.
2.6  Explain causes of quality variation.
2.7  State the characteristics of normal distribution curve.
2.8  Explain control charts with classification, advantages and applications.
2.9 Construct control charts for variables data and attributes data .
2.10 Interpret control charts for " Process in control" or Process out of control".
2.11 List advantages and disadvantages of acceptance sampling over 100% inspection.
2.12 State the Principles of random sampling.
2.13 Explain the procedure for accepting a lot by single sampling plan only.
2.14 Explain the concept of Six Sigma.

## 3.0 Fundamentals of Estimation and Costing.
3.1. Define Estimation and Costing.
3.2. List objectives of Estimation and Costing.
3.3. Differentiate between estimation and costing of a product.
3.4 Outline Estimation procedure
3.5. Explain various Elements of costing
3.6. Explain various components of costing.
3.7  Calculate selling price of a Product
3.8. Solve simple numerical problems on selling price of products.
3.9  Define Depreciation
3.10. Explain the causes of depreciation
3.11. List various methods of calculating depreciation.
3.12  Compute depreciation charges by 1) Straight Line method 2) Sinking Fund Method  and 3)  Sum of Years' Digits method.

## 4. Estimation of Weights and Machining Times
4.1 Calculation of volume, weight and material cost of manufacturing a given component. 4.2 Estimation of Machining times - calculation of  turning, knurling, facing, drilling, boring, reaming, threading, tapping, shaping, planning and grinding operation times performed on the given component.

## 5. Estimation of Forging and Welding Costs

  5.1 Explain various forging losses.

  5.2 Estimate the length for a given component by forging.

  5.3 Estimate the weight of material required for a given component by forging

  5.4 Estimate the cost of forging

  5.5 Estimate the cost of Fabrication by Gas welding

  5.6 Estimate the cost of Fabrication by Arc welding.

  5.7 Estimate the cost of Gas cutting.

## COURSE CONTENT

### 1.0 Work Study

Industrial Engineering : Definition of Production and productivity;

Work Study: Definition, objectives and scope of work study.

Method Study: Definition, objectives, procedure of conducting method study – Process chart symbols – Explanation with Operation process chart, Flow process chart and Two handed process charts only - Uses of flow diagram and string diagram.

Micro-motion study: Therbligs used in the micro-motion study - SIMO chart – Chrono cycle graph.

Work Measurement or Time study: Definition, objectives - Work measurement techniques.

Time Study: Procedure by using a stop watch to measure the standard time- Constituents of standard time: Normal time- rating factor- allowances – Simple Problems.

Standard data - Determination of standard time by using Predetermined Motion Time Standards ( PMTS) - Determination of standard time by using work sampling.

Wage and incentive plans : Definitions of wage, nominal wage, real wage, living wage, minimum wage , fair wage and incentive- List different incentive plans - Solve simple problems on Halsey, Rowan and Emerson efficiency plans only.

### 2.0 Statistical Quality Control (SQC)

The Meaning of Quality - objectives of inspection - methods of inspection – floor or patrolling inspection - centralised inspection –trial run inspection- first piece inspection - pilot piece inspection - sample inspection – merits and demerits of the above -

Statistical Quality Control: Definition - Chance and assignable causes – Quality control tools – Types of statistical data – variables and attributes data – Normal distribution curve;

Control Charts for variables data- Construction of Control Charts for X-Bar and R- Charts. Interpretation of control charts to know whether the process is out of control or in control - Simple Numerical Problems.

Control charts for attributes data: Fraction defective (p), percent defective (100p) , Number of Defectives (np) charts - Simple Numerical Problems.
Acceptance sampling plan – advantages and disadvantages of sampling plan over 100% inspection – Single sampling plan for accepting a lot with a flow chart – Principles of random sampling;
Six sigma: Importance – Objectives – advantages.

### 3.0 Fundamentals of Estimation and Costing

Estimating: Importance and objectives, Estimating Procedure
Costing- Definition – objectives - Difference between Estimating and Costing
Elements of costs – Components of costs - Calculate selling price of a Product- Numerical Problems -
Depreciation: Definition – Causes - methods of depreciation - Simple problems on calculation of depreciation Fund by 1) Straight Line method 2) Sinking Fund Method and 3) Sum of Years' Digits method.

### 4.0 Estimation of Weights and Machining Times

Estimation of Weight of given compoent: Calculation of volume, weight and material cost of manufacturing a given component - Simple Numerical Problems.

Estimation of Machining times - calculation of turning, knurling, facing, drilling, boring, reaming, threading, tapping, shaping, planning and grinding operation times performed on the given component- Simple Numerical Problems.

### 5.0 Estimation of Forging and Welding Costs.

Forging Cost : Types of forging operations, Estimation procedure – Forging losses -  estimating forging cost of given component by considering losses – Simple Numerical Problems.
Welding cost :  Type of welding processes - Types of joints - Calculate arc welding and gas welding costs for making the given joint by considering material, labour, and power costs - Gas cutting cost -   Simple numerical problems.

### REFERENCE BOOKS

1.    Work study – by Ralph Banes.
2.    Work study – by I.L.O.
4.    Industrial Engineering & Management    Science - by T.R. Banga
5.    S.Q.C – by Grant & Levenworth
6.    S.Q.C -by Juran
7.    S.Q.C -by Gupta
8.     Mechanical Estimating & Costing                   - B.P.Sinha
9.    Estimating & Costing                          - Agarwal.
10.    Estimating & Costing                         - Narang & charya.
11.    Estimating & Costing                          - T.R. Banga – Sharma.

# THEORY OF MACHINES

| Course Title | Course Code | Periods/Week | Periods/Semester |
|---|---|---|---|
| Theory of Machines | M–503 | 04 | 60 |

## TIME SCHEDULE

| S. No | Chapter/Unit Title | Periods | Weightage of Marks | Short Answer Questions (3M) | Essay Type Questions (8M) | Higher Order Question (10M) |
|---|---|---|---|---|---|---|
| 1 | Belts and chain drives | 12 | 14 | 2 | 1 | * |
| 2 | Gear drives | 12 | 14 | 2 | 1 | * |
| 3 | Fly wheels and Governors | 12 | 14 | 2 | 1 | - |
| 4 | Cams | 12 | 14 | 2 | 1 | * |
| 5 | Mechanical Vibrations | 12 | 14 | 2 | 1 | |
| | Total | 60 | 70+10 | 10 | 05 | 01 |

**Note: * 10 Marks higher order question may be given from the Chapter-1 or Chapter- 2 or  Chapter - 4.**

## Course Outcomes and Course Objectives

| Course objectives | Upon completion of course the student shall be able to understand the working principles and applications of various mechanisms like belts, chains, gears and clutches and other machine controlling elements viz., flywheel, governor and cams in Mechanical Engineering. | | |
|---|---|---|---|
| **Course outcomes** | **CO1** | M-503.1 | Design the belt drive to transmit the given power by considering the centrifugal tension |
| | **CO2** | M-503.2 | Design the gear train like 1. Simple, 2. Compound and 3. Reverted gear train for practical applications |
| | **CO3** | M-503.3 | Design the gear based on Lewis equation by taking the dynamic effect of the load into consideration in the form of velocity factor. |
| | CO4 | M-503.4 | Explain the functions of the machine control elements like Flywheel, Governor, and Cam |
| | CO5 | M-503.5 | Explain the basics of mechanical vibrations |

**MODEL BLUE PRINT OF THE QUESTION PAPER**

| Sl. No | Chapter Name | Periods Allocated | Weightage Allocated | Marks Wise Distribution of Weightage | | | | Question Wise Distribution of Weightage | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | R | U | Ap | An | R | U | Ap | An |
| 1 | Belt and Chain drives | 12 | 14 | 03 | 03 | 8 | - | 1 | 1 | 1 | - |
| 2 | Gear drives | 12 | 14 | 03 | 03 | 8 | 10 | 1 | 1 | 1 | 1 |
| 3 | Fly wheels and Governors | 12 | 14 | 03 | 03 | 8 | - | 1 | 1 | 1 | - |
| 4 | Cams | 12 | 14 | 03 | 03 | 8 | - | 1 | 1 | 1 | - |
| 5 | Mechanical Vibrations | 12 | 14 | 03 | 03 | 8 | - | 1 | 1 | 1 | |
| | **Total** | **60** | **70+10** | **15** | **15** | **40** | **10** | **05** | **5** | **05** | **01** |

R-Remembering;     U-Understanding;     Ap-Applying;     An- Analylising
**Note: *  10 Marks higher order question may be given from the Chapter-1 or Chapter- 2 or  Chapter - 4.  (Here it is taken from the Chapter– 2)**

**LEARNING OUTCOMES**
Upon completion of the course student shall be able to
**1.0 Belts and Chain Drives**
    1.1    List the different power drives and compare the flexible drives with the rigid drives
    1.2    Classify the belt drives on different criteria and list the belt materials
    1.3    Explain the effect of slip and creep on power transmission
    1.4    Write the expression for calculating the length of open and cross belts.
    1.5    Write the expression for calculating the angle of contacts of open and cross belts.
    1.6    Write the expression for i) ratio of belt tensions ii) centrifugal tension in the belt
    1.7    Explain the effect of centrifugal tension on power transmission
    1.8    Write the condition for maximum power transmission
    1.9    Solve the numerical problems related to the lengths, angle of contact, ratio of tensions, power transmitted by the belt drives.
    1.10    Design the cross-sectional dimensions of flat belt (V-belts are excluded)
    1.11    Design the cone pulley for open and cross belts
    1.12    List the different elements of chain drive
    1.13    Classify the chain drives
    1.14    Differentiate belt and chain drives
**2.0 Gear Drives**
    2.1  List the advantages and disadvantages of gear drives over belt and chain drives
    2.2  Define gear train and List different types of gear trains

2.3 Write the expression for the velocity ratio / Train value for different gear trains except Epi-cyclic gear trains

2.4 Explain the working of simple, compound, epy-cyclic and reverted gear trains.

2.5 Solve the problems related to simple, compound and reverted gear trains

2.6 Explain with a neat sketch the working of back gear assembly of a lathe

2.7 Design a 3-Speed gear box of an automobile – simple problems .

2.8 Explain the nomenclature of spur gear tooth.

2.9 Differentiate the involute profile from Cycloidal profile

2.10 List the required properties of gear materials

2.11 Write the Lewis bending equation.

2.12 Design the gear based on Lewis equation –Simple Problems only

## 3.0 Flywheels and Governor

3.1 State the function of flywheel, list its applications.

3.2 Explain the terms related to flywheel

3.3 Write the expression for maximum fluctuation of energy

3.4 Define Mass Moment of Inertia

3.5 Design the rim type flywheel for the given maximum fluctuation of energy.

3.6 Solve simple problems on fly wheel.

3.7 Explain the function of governor.

3.8 Classify the governors

3.9 Distinguish Governor from Flywheel

3.10 Describe the working of Watt governor with legible sketch.

3.11 Describe the working of governor with legible sketch.

3.12 Define the terms – sensitiveness, stability, isochronism, hunting, effort and power of governor.

## 4.0 Cams

4.1 Explain the function of cam assembly

4.2 Classify the cams and followers

4.3 Define the terms related to cam profile.

4.4 Draw displacement diagram for different the following motion of the followers a) Uniform velocity.    b) S.H.M.  c) Uniform acceleration & retardation

4.5 Draw cam profiles in above three cases for knife edge and roller followers. **(Off-set followers are omitted)**

## 5.0 Introduction to Mechanical Vibrations

5.1 Define periodic motion, frequency, time period, amplitude, circular frequency, degree of freedom

5.2 Classify the mechanical vibrations on different criteria.

5.3 Explain the Simple Harmonic motion and its properties, Natural frequency and resonance

5.4 List various elements of mechanical vibrating systems.

5.5 Explain the following terms (a) spring element (b) damping element (c) Inertia element

5.6 List the types of damping.

5.7 Define the terms (a) Viscous damping (b) Coulomb damping (c) Structural damping

5.8 Appreciate the study of vibrations in the analysis and design of mechanical systems.

5.9  Write the expression for the natural frequency of single degree spring-mass system- simple problems. **(Derivation omitted)**

5.10  Write the expression for the natural frequency of single degree Simple pendulum - simple problems. **(Derivation omitted)**

5.11  Explain the sources of vibrations in mechanical systems

5.12  Explain the methods of controlling the vibrations in mechanical systems

## COURSE CONTENT

### 1. Belt and Chain Drives

Factors to be considered while selecting the type of power drive – Advantages and Disadvantages of Belt drives - Types of belt drives - Belt materials - Belt joints.

Mathematical expression for the  length and angle of contacts of open and crossed belts -

Mathematical expression for the limiting ratio of belt tensions - Concept of centrifugal tension and initial tension – Mathematical expressions for the centrifugal tension in the belt and initial tension– Mathematical expression for the maximum power transmission **(Derivations for mathematical expressions are omitted)**

Simple Numerical Problems on finding the length, angle of contact, stresses, cross-sectional dimensions, power transmission and maximum power transmission considering with or without the centrifugal tension.

Design of stepped pulley;

Chain drives – Advantages of chain drives - Types of chains – Roller and silent chains - (problems on chain drives omitted)

### 2. Gear drives

Advantages and disadvantages of gear drives over other drives - Gear train - Simple, compound, reverted & Epi-cyclic gear trains. – Calculating the number of teeth for simple, compound and reverted gear trains for a given speed ratio and sketching the arrangement-Applications of gear trains –back gear assembly of lathe with a neat sketch;

Design of 3-Speed gear box of an automobile – Simple problems.

Involute and Cycloidal profiles – Comparison of these two profiles – Nomenclature of spur gear tooth – Gear materials.

Design of spur gear based on Lewis equation by considering static load only. **(Velocity factor is not included in the problems)**

### 3  Fly wheels and Governors

Function and applications of fly wheels -Turning Moment diagram for 4-stroke single cylinder engine – Definition of Coefficient of fluctuation of speed, maximum fluctuation in energy and Coefficient of fluctuation of energy – Mathematical expression for energy stored in the flywheel **(without proof)** –Importance of mass

moment of inertia - Design of rim type flywheel knowing the fluctuation of energy–simple problems

Governor – functions – Difference between Flywheel and Governor - Classification - Explanation of Simple Watt governor and Porter governor – Definitions of Sensitiveness, Stability, Isochronism, Hunting, Effort and Power of governor.

## 4. Cams

Function of cam - Classification of cams and followers –Working principle of plate and cylindrical cams.

Nomenclature of radial cam profile.

Motions of follower – Uniform velocity, uniform acceleration and retardation and simple harmonic motion – Time vs displacement diagrams only –

Construction of cam profile of a radial cam with knife edge & roller follower for all three types of motions stated above.

Problems on drawing of cam profiles as stated above for knife edge & roller followers **(offset followers not included).**

## 5. Introduction to Mechanical vibrations

Periodic Motion – frequency, time period, amplitude, circular frequency, degree of freedom;   Elements of mechanical vibrating systems - (a) spring element (b) damping element (c) Inertia element.

Types of damping – viscous, Coulomb and structural damping

Classification of mechanical vibrations – free, damped, forced and damped forced vibrations

SHM – Natural frequency – resonance – problems on determining the natural frequency of single degree of freedom systems for spring mass system and simple pendulum.

Sources of vibrations in mechanical systems

Methods of controlling the vibrations in mechanical systems.


**REFERENCES**

1.    Machine Design                  -       Pandya and Shah.  CHAROTAR

2.    Design of Machine Elements  –     V B Bhandari    [ Tata Mc Graw Hill]

3.    Machine Design                  -       R.S.Khurmi         [ S.CHAND]

4.    Theory of machines        -     S.S. RATHAN       [ Tata Mc Graw Hill]

5.    Mechanical Vibrations        -       S.S. RAO            Addison Wesley

# HEAT POWER ENGINEERING - II

| Course Title | Course Code | Periods/Week | Periods per Semester |
|---|---|---|---|
| Heat Power Engineering - II | M-504 | 04 | 60 |

## TIME SCHEDULE

| S. No. | Chapter/Unit Title | Periods | Weightage of Marks | Short Answer Questions (3M) | Essay Type Questions (8M) | Higher Order Question (10M) |
|---|---|---|---|---|---|---|
| 1 | Properties of Steam | 12 | 17 | 03 | 01 | |
| 2 | Steam Boilers | 12 | 14 | 02 | 01 | |
| 3 | Steam Nozzles | 12 | 14 | 02 | 01 | 01 |
| 4 | Steam Turbines | 14 | 11 | 01 | 01 | |
| 5 | Steam Condensers | 10 | 14 | 02 | 01 | |
| | **Total** | **60** | **70+10** | **10** | **05** | **01** |

**Note: 10 Marks higher order question may be given from the Chapter 2 or 3 or 4.**

## Course Objectives and Course Outcomes

| Course Objectives | | | Upon completion of the course the student shall be able to: Apply the principle and concepts of Heat Power Engineering to solve the contemporary real time applications |
|---|---|---|---|
| Course Outcomes | CO1 | M-504.1 | Determine the properties of pure substance |
| | CO2 | M-504.2 | Explain the Working of 1.Steam Boilers, 2.Steam Nozzles, 3.Steam Turbines and 4.Steam Condensers |
| | CO3 | M-504.3 | Evaluate the Performance of Boilers, Nozzles, turbines and Condensers from the basics of thermodynamics |
| | CO4 | M-504.4 | Solve numerical problems related to steam in the Mechanical Engineering devices |

**Model Blue Print of the Question Paper**

| S. No | Chapter Name | Periods Allocated | Weightage Allocated | Marks Wise Distribution of Weightage | | | | Question Wise Distribution of Weightage | | | | CO's Mapped |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | R | U | Ap | An | R | U | Ap | An | |
| 1 | Properties of Steam | 12 | 17 | 03 | 06 | 08 | | 01 | 02 | 01 | | CO1 |
| 2 | Steam Boilers | 12 | 14 | 03 | 03 | 08 | | 01 | 01 | 01 | | CO2, CO3, CO4 |
| 3 | Steam Nozzles | 12 | 14 | 03 | 03 | 08 | | 01 | 01 | 01 | | CO2, CO3, CO4 |
| 4 | Steam Turbines | 14 | 21 | - | 03 | 08 | 10 | - | 01 | 01 | 01 | CO2, CO3, CO4 |
| 5 | Steam Condensers | 10 | 14 | 03 | 03 | 08 | | 01 | 01 | 01 | | CO2, CO3, CO4 |
| | **TOTAL** | **60** | **80** | **12** | **18** | **40** | **10** | **04** | **06** | **05** | **01** | |

R-Remember;        U-Understanding;   Ap-Application ; An- Analylising

**Note:  10 Marks higher order question may be given from the Chapter - 2 or 3 or 4. (Here it is taken from chapter – 4)**

**Learning Outcomes**
Upon on completion of the course the student shall be able to:

**1.0    Properties of Steam**
   1.1    Define the terms (a) Dryness fraction (b) Degree of super heat of steam.
   1.2    Define the properties:  enthalpy, internal energy and entropy of the steam.
   1.3    Compute the enthalpy, internal energy and entropy at a given pressure.
   1.4    Use the steam tables to calculate the enthalpy and entropy.
   1.5    Compute the enthalpy and entropy values using Mollier chart.
   1.6    Solve simple problems on the specific volume, enthalpy and entropy.
   1.7    Compute the heat transfer, work transfer, change in internal energy, change in enthalpy and change in entropy of steam in Isochoric, Isobaric, Isothermal, Adiabatic Throttling and Polytropic processes.
   1.8    Represent the above process on p-V and T-s diagrams
   1.9    Calculate dryness fraction by using Steam calorimeters.

### 2.0 Steam Boilers
2.1 State the function of a boiler and list the uses of boilers
2.2 Describe with a legible sketch the working of Cochran Boiler and Babcock Wilcox Boiler
2.3 Distinguish between water tube and fire-tube boilers
2.4 State the need of high pressure modern boilers
2.5 Explain the working principle of Lamont and Benson Boilers with legible sketches.
2.6 Explain the function of the mountings such as pressure gauge, water level indicator, safety valve fusible plug, blow down cock and stop valve.
2.7 Illustrate the function of the accessories such as feed pump, air preheater, economiser, Super Heater, Steam traps and steam Separators.
2.8 Define and explain the terms (a) Equivalent evaporation (b) Factor of evaporation (c) Boiler Power (d) Boiler efficiency
2.9 Solve problems on Boiler Power, Boiler Efficiency, Equivalent evaporation and Factor of evaporation.
2.10 Prepare heat balance sheet for boiler performance
2.11 List various draught systems.
2.12 Explain draught systems : Natural, forced & induced with a legible sketches

### 3.0 Steam Nozzles
3.1 Explain the Flow of steam through nozzle
3.2 Derive an expression for Velocity of steam at the exit of nozzle in terms of heat drop analytically and by using Mollier chart.
3.3 Calculate Velocity of steam at the exit of nozzle in terms of heat drop analytically and by using Mollier chart.
3.4 Write the expression for 1. Discharge of steam through nozzles and 2. Critical pressure ratio.
3.5 Calculate cross-sectional area at throat and at exit for the maximum discharge
3.6 Explain the Effect of friction in nozzles.
3.7 Explain the Working of steam jet injector with a legible sketch.
3.8 Solve simple problems on flow through nozzles.

### 4.0 Steam Turbines
4.1 Explain the principle of working of a steam turbine.
4.2 Classify the Turbines with examples.
4.3 Differentiate an impulse turbine from a reaction turbine
4.4 Explain the Principle of working of a simple De-Laval turbine with a line diagram.
4.5 Draw velocity triangles for a simple impulse turbine
4.6 Derive formula for work done, axial thrust, energy lost, power and efficiencies.
4.7 State the necessity of compounding a turbine.
4.8 Describe the methods of reducing rotor speeds with the help of legible sketch (3 compounding methods)

4.9     Explain the working principle of Parson's Reaction Turbine with a line diagram.

4.10   Draw Velocity triangle for Parson's reaction turbine.

4.11   Solve simple problems on Single stage Impulse turbines (without blade friction) and reaction turbines (including data on blade height)

4.12   Define the terms bleeding & reheating.

4.13   State the necessity of governing of a steam turbine.

4.14   Explain various methods of governing systems in turbines.

## 5.0   Steam Condensers

5.1     Define a Steam condenser and State functions of steam condenser

5.2     Classify the condensers based on three criteria

5.3     Describe the working principle of 1. Low level counter Flow and 2. Parallel flow jet condensers with legible sketch

5.4     Explain the working principle of a High level Jet condenser with legible sketch

5.5     List the three Advantages and three Disadvantages of High- Level Jet condenser

5.6     Describe the working principle of Ejector condenser with Shell and Tube Surface condenser with legible sketch

5.7     Distinguish between down flow and central flow surface condenser

5.8     Explain the working principle of Evaporative condenser with legible sketch

5.9     List the three Advantages and three Disadvantages of Surface condenser

5.10   Distinguish between Jet Condenser and Surface Condenser

5.11   Write the Formulae for cooling water required, Condenser efficiency, corrected vacuum, absolute pressure and Vacuum efficiency .

5.12   Solve simple problems on Condenser efficiency and Vacuum efficiency

## COURSE CONTENT

## 1.0   Properties of steam

Formation of steam under constant pressure, dryness fraction and degree of superheat, specific volume. Determination of enthalpy, internal energy, internal latent heat, entropy of wet, dry and superheated steam at a given pressure using steam tables and Mollier chart.

Compute the heat transfer, work transfer, change in internal energy, change in enthalpy and change in entropy of steam in Isochoric, Isobaric, Isothermal, Adiabatic Throttling and Polytropic processes.

Simple direct problems on the above using tables and charts.

Vapour processes – simple problems using tables and charts.

Steam calorimeters – Separating, throttling, Combined Separating and throttling calorimeters – problems.

## 2.0   Steam Boilers

Function and use of steam boilers. Classification of steam boiler with examples. Brief explanation with line sketches of Cochran and Babcock Wilcox Boilers. Comparison of water tube and fire tube boilers.

Description with line sketches of modern high pressure boilers- Lamont and Benson boilers. Brief explanation of boiler mountings namely, pressure

gauge, water level indicator, fusible plug, blow down cock, stop valve, safety valves (dead weight type, spring loaded type).

Brief explanation of boiler accessories such as feed pump, economiser, super heater and air pre-heater only.

Study of steam traps & separators.

Define the terms : Actual evaporation, equivalent evaporation, factor of evaporation, boiler horse power and boiler efficiency. Simple direct problems on the above.

Explain various Draught systems (Natural, forced & induced).

### 3.0 Steam Nozzles

Flow of steam through nozzle.

Velocity of steam at the exit of nozzle in terms of heat drop by analytical and Mollier diagram. Discharge of steam through nozzles. Critical pressure ratio.

Methods of calculation of cross – sectional areas at throat and exit for maximum discharge. Effect of friction in nozzles .

Working of steam jet injector. Simple problems on nozzles.

### 4.0 Steam Turbines

Classification of steam turbines with examples. Difference between impulse & reaction turbines.

Principle of working of a simple De-Laval turbine with line diagrams. Velocity diagrams. Expression for work done, axial thrust, tangential thrust, blade and diagram efficiency, stage efficiency, nozzle efficiency.

Methods of reducing rotor speed, compounding for velocity, for pressure or both pressure and velocity.

Working principle with line diagram of a Parson's Reaction turbine – velocity diagram. Simple problems on single stage impulse turbines (without blade friction) and reaction turbine including data on blade height.

Bleeding, re- heating and re-heating factors (Problems omitted).

Governing of steam turbines -Throttle, By-pass & Nozzle control governing.

### 5.0 Steam Condensers

Steam condenser, its functions, Classifications. Low level counter flow and parallel flow jet condensers, High level Jet condenser and Ejector condenser. Advantages and Disadvantages of High- Level Jet condenser.

Shell and Tube Surface condenser, Down flow, Central flow Surface Condenser and Evaporative condenser.

Advantages and Disadvantages of Surface condensers.

Write the formulae for cooling water required, Condenser efficiency, Corrected vacuum, Absolute pressure and Vacuum efficiency – Simple problems.


**REFERENCE BOOKS**

1. P.L.Ballaney, Thermal Engineering, 1966, Khanna Publishers
2. R.C. Patel & C.J. Karamchandani, Elements of Heat Engines –Volume II, 1963, Acharya Book Depot
3. Arora & S. Domkundwar, A course in Thermal Engineering, 2016, Dhanpat Rai
4. A.S.Sarao, Thermal Engineering, 2016, Satya Publications

# REFRIGERATION & AIR CONDITIONING

| Course Title | Course Code | Priods/Week | Periods per Semester |
|---|---|---|---|
| Refrigeration & Air Conditioning | M-505 | 05 | 75 |

## TIME SCHEDULE

| SNo. | Chapter/Unit Title | No. of Periods | Weightage of Marks | Short Answer Questions (3M) | Essay Type Questions (8M) | Higher Order Question (10M) |
|---|---|---|---|---|---|---|
| 1. | Fundamentals of Refrigeration | 10 | 14 | 02 | 01 | |
| 2. | Vapour compression & Vapour absorption Refrigeration Systems | 18 | 14 | 02 | 01 | * |
| 3. | Refrigeration equipment & Applications of Refrigeration. | 16 | 14 | 02 | 01 | * |
| 4. | Air Conditioning & Psychrometry | 15 | 14 | 02 | 01 | |
| 5. | Air Conditioning Equipment & Applications of Air Conditioning. | 16 | 14 | 02 | 01 | * |
| | Total | 75 | 70+10 | 10 | 05 | 01 |

**Note: * 10 Marks higher order question may be given from the Chapter-2 or 3 or 5.**

**Course Objectives and Course Outcomes**

| Course Objectives | | | *Upon completion of the course the student shall be able to:* Apply the principles and concepts of thermodynamics and Psychometric to design the Refrigeration and Air Conditioning Systems |
|---|---|---|---|
| Course Outcomes | CO1 | M-505.1 | Analyse air refrigeration cycles, Vapour Compression and Vapour Absorption Refrigeration cycles. |
| | CO2 | M-505.2 | Explain the use of Refrigerants and their effect on environment |

| | CO3 | M-505.3 | Describe the Working of Refrigeration and Air Conditioning equipment. |
|---|---|---|---|
| | CO4 | M-505.4 | Explain the various psychometric properties and Processes |
| | CO5 | M-505.5 | Explain the applications of Refrigeration and Air Conditioning systems. |

**Model Blue Print of a Question Paper**

| Sl. No | Chapter Name | Periods Allocated | Weightage Allocated | Marks Wise Distribution of Weightage | | | | Question Wise Distribution of Weightage | | | | CO's Mapped |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | R | U | Ap | An | R | U | Ap | An | |
| 1 | Fundamentals of Refrigeration | 10 | 14 | 03 | 03 | 08 | | 01 | 01 | 01 | | CO1 |
| 2 | Vapour Compression & Vapour Absorption Refrigeration Systems | 18 | 24 | 03 | 03 | 08 | 10 | 01 | 01 | 01 | 01 | CO1 |
| 3 | Refrigeration equipment & Applications of Refrigeration. | 16 | 14 | 03 | 03 | 08 | | 01 | 01 | 01 | | CO2, CO3, CO5 |
| 4 | Air Conditioning & Psychrometry | 15 | 14 | 03 | 03 | 08 | | 01 | 01 | 01 | | CO3 |
| 5 | Air Conditioning Equipment & Applications of Air Conditioning. | 16 | 14 | 03 | 03 | 08 | | 01 | 01 | 01 | | CO4, CO5 |
| | **TOTAL** | **75** | **80** | **15** | **15** | **40** | **10** | **05** | **05** | **05** | **01** | |

R-Remembering;     U-Understanding;     Ap-Applying;     An- Analylising
**Note:**
**10 Marks higher order question may be given from the Chapter -2 or 3 or 5 ( Here it is taken from chapter- 2)**


**Learning Outcomes**


Upon on completion of the course the student shall be able to:

**1.0    Fundamentals of Refrigeration**
1.1    Define the term 'Refrigeration'.
1.2    Explain different methods of refrigeration such as ice refrigeration, dry-ice refrigeration, steam jet refrigeration, liquid gas refrigeration. Define the term 'Ton of Refrigeration'. Give the value in S.I units.
1.3    Define the term 'Coefficient of Performance'.

1.4 Estimate the power required per ton of refrigeration.
1.5 Explain the principle of open air refrigeration.
1.6 Explain the Carnot refrigeration cycle by plotting it on p-V and T-s diagrams.
1.7 Explain the Bell-Coleman air refrigeration cycle plotting it on p-V and T-s diagrams.
1.8 Calculate the COP of Carnot refrigeration cycle
1.9 Calculate the COP of Bell-Coleman air refrigeration cycle
1.10 Explain the principle of Open air refrigeration system.
1.11 Explain the principle of closed air refrigeration system.
1.12 Distinguish between open air refrigeration system and closed air refrigeration system.

## 2.0 Vapour Compression and Vapour Absorption Refrigeration Systems.

2.1 Describe the Main components of a vapour compression refrigeration system with flash chamber and accumulator.
2.2 Explain vapour compression refrigeration system with the help of T-s and p-H diagrams.
2.3 Distinguish between wet and dry compression.
2.4 Explain the effects of under cooling and super heating on COP in vapour compression refrigeration system.
2.5 Explain the effects of pressure changes on COP in vapour compression refrigeration system.
2.6 Calculate COP of vapour compression refrigeration Cycle – simple problems .
2.7 Explain the principle of simple vapour absorption refrigeration system.
2.8 List the refrigerant – Absorber pairs in the vapour absorption refrigeration system. Write the desirable properties of refrigerant and absorbent pairs.
2.9 Describe the working principle of a vapour absorption refrigeration system with the help of a legible sketch. Calculate "COP" of the ideal vapour absorption refrigeration system.
2.10 Differentiate between the two fluid and the three fluid absorption systems.
2.11 Describe the working of Electrolux refrigerator with the help of a legible sketch.
2.12 Describe the working of a solar powered vapour absorption refrigeration system with the help of a legible sketch.
2.13 Distinguish between primary and secondary refrigerants.
2.14 List the properties of the refrigerants and commonly used refrigerants.

## 3.0 Refrigeration Equipment & Applications of Refrigeration.

3.1 Explain different types of compressors such as reciprocating and rotary compressors.
3.2 State the function of a condenser and classify the condensers.
3.3 Describe the different types of condensers such as shell & tube, shell and coil type with the help of legible sketches.
3.4 State the function of evaporator and classify the evaporators.
3.5 Explain the working of shell & tube, shell and coil, flooded type evaporators with the help of legible sketches.
3.6 State the function of expansion devices and classify expansion devices.

3.7    Explain the working of expansion devices such as capillary tube, thermostatic expansion valves and solenoid valves with the help of a legible sketch.

3.8    Explain the refill type and throw away type dryers.

3.9    Describe the working of a domestic refrigerator with the help of a legible sketch.

3.10    Describe the working of an ice plant with the help of a legible sketch.

3.11    Describe the working of a water cooler with the help of a legible sketch.

3.12    Describe the working of a cold storage with the help of a legible sketch.

## 4.0    Air Conditioning  & Psychrometry

4.1    Define air conditioning.

4.2    List modern applications of air conditioning.

4.3    Explain Air conditioning as applied to human comfort.

4.4    Define Psychrometry- Define the terms :humidity, Relative humidity, dew point, DBT & WBT, Absolute humidity, humidity ratio relative to Psychrometry – Simple problems .

4.5    Explain the features of Psychrometric chart.

4.6    List and explain various Psychrometric processes with the help of Psychrometric chart.

## 5.0    Air Conditioning Equipment & Applications of Air conditioning

5.1    Describe various air conditioning equipment like fans, ducts, filters (wet, dry, electric & viscous types), centrifugal dust collector with the help of legible sketches.

5.2    Explain the use of heating and cooling coils.

5.3    Explain various air distribution systems.

5.4    Describe the working of an air cooler with a neat sketch.

5.5    Describe the working of a window air – conditioner with a neat sketch.

5.6    Purpose of cooling towers – Classification;

5.7    Explain the working of Natural draft cooling tower with a neat sketch.

5.8    Explain the working of induced draft and forced draft cooling towers with neat sketches.

5.9    Explain the working of centralised air conditioning system.

5.10    Illustrate the working of summer air conditioning system.

5.11    Illustrate the working of winter air conditioning system.

5.12    Illustrate the working of year round air conditioning system.

## COURSE CONTENT

### 1.0    Fundamentals of Refrigeration

Introduction – Definition and meaning of refrigeration, methods of refrigeration – unit of refrigeration – Refrigeration effect – Coefficient of Performance.

Thermodynamic analysis of Carnot refrigeration cycle – Air refrigeration cycle (Bell – Coleman) - Simple Numerical Problems.

Open air and closed air systems of refrigeration.

**2.0 Vapour Compression & Vapour Absorption Refrigeration Systems.**

Working and analysis of vapour compression refrigeration system with the help of T-s & p-H diagrams – wet, dry and superheated compression – Refrigerating effect – Simple problems.

Effect of pressure changes on C.O.P- Effect of sub – cooling of COP and capacity – Effect of super heating of vapour before compression –

Refrigerants - Primary and secondary refrigerants with examples – Requirements of a refrigerant – properties of refrigerants – Commonly used refrigerants.

Principle of vapour absorption refrigeration cycle -   C.O.P of vapour absorption system  – Simple Problems.

Properties Refrigerant and absorbent pairs properties – two fluid & three fluid systems – Electrolux refrigerator - Solar powered refrigeration system – comparison of vapour absorption and vapour compression systems.

**3.0 Refrigeration Equipment and Applications of Refrigeration.**

Equipment used in Refrigeration systems;

Compressors – types of compressors – Working of Hermetically sealed compressor with sketches – Working of vane type rotary compressor with a neat sketch.

Condensers – types of condensers – Working of Air cooled, Water cooled and Evaporative type condensers with sketches.

 Evaporators – types of evaporators – Working principle of shell and tube, flooded type evaporators with sketches.

Expansion devices – types of expansion devices – Working of capillary tube, thermostatic expansion devices with neat sketches.

Refill type and throw away type driers.

Applications of Refrigeration: Working of Domestic refrigerator, ice plant, Water cooler and  cold storage plant with neat sketches.

## AIR CONDITIONING

**4.0    Air Conditioning & Psychrometry**

Definition of air conditioning – Applications- Classification - Human comfort – Factors effecting human comfort - effective temperature – Factors governing effective temperature conditions that affect body heat – comfort chart.

Psychrometry – Definitions of Psychrometric terms– dry air, wet air, moist air, saturate air, Partial pressure,  humidity, Relative humidity, dew point, DBT & WBT, Absolute humidity, humidity ratio,  Degree of saturation, sensible heat, latent heat and total heat of moist air.

Explanation of Sling Psychrometer and Aspirating Psychrometer;

Psychrometric chart - List and explanation of various psychrometric processes with the help of Psychrometric chart – Sensible heat factor -mixing of air streams.

Cooling load: definition – List the components involved in computation of cooling load.

Heating load: definition – List the components involved in computation of heating load.

Solving simple problems using psychrometric chart and mathematical formulas.

## 5.0 Air Conditioning Equipment & Applications of air conditioning

Air Conditioning equipment such as fans, supply ducts, outlets, return outlets and ducts- Grills –dampers – registers -humidifiers – dehumidifiers-

Filters & dust collectors – wet, dry, electrostatic and viscous types- Heating and cooling coils

Air distribution: Radial perimeter, loop perimeter and extended plenum systems – Simple Ejector system -Downward air distribution system – Upward air distribution system.

Applications of Air conditioning: Illustrate working of Air coolers –Split type window air conditioner

Working of Cooling Towers:- Natural , induced draft and forced draft cooling towers.

A/C systems: Working of Summer, winter, year round air conditioning systems - Central A/C system – unitary system.

## REFERENCE BOOKS

1. Arora C P, Refrigeration and Air Conditioning, 2009, MGH Publishers
2. P N Ananthanarayana, Basic Refrigeration and Air conditioning, 2013, MGH Publishers
3. John Tomczyk, Troubleshooting and Servicing Modern Air Conditioning and Refrigeration Systems, 1995, Esco Press

# COMPUTER AIDED MANUFACTURING SYSTEMS

| Course Title | Course Code | Periods per week | Period per semester |
|---|---|---|---|
| Computer Aided Manufacturing Systems | M-506 | 04 | 60 |

## TIME SCHEDULE

| S. No. | Chapter / Unit Title | Periods | Weightage of Marks | Short Answer Questions (3M) | Essay Type Questions (8M) | Essay Type Question (10M) |
|---|---|---|---|---|---|---|
| 1 | Introduction to Computer aided manufacturing | 07 | 06 | 02 | | |
| 2 | NC, CNC and DNC Systems | 13 | 14 | 02 | 01 | 01 |
| 3 | CNC programming | 14 | 18 | 00 | 01 | |
| 4 | Material handling systems of CAM | 10 | 17 | 03 | 01 | |
| 5 | Flexible manufacturing systems and Rapid Prototyping | 16 | 25 | 03 | 02 | |
| | **Total** | 60 | **70+10** | **10** | **05** | **01** |

**Note: Higher order question may be given from Chapter 2 or 3.**

**Course Outcomes and Course Objectives**

| Upon completion of the course the student shall be able to | | | |
|---|---|---|---|
| **COURSE OBJECTIVES** | 01 | | Describe computer aided manufacturing systems, develop CNC part programming |
| | 02 | | Explain the material handling systems, flexible manufacturing system and computer integrated manufacturing systems. |
| **COURSE OUTCOMES** | CO1 | M-506.1 | Explain computer aided manufacturing, integrated CAD/CAM system, group technology, advantages and limitations of group technology. |

| | C02 | M-506.2 | Describe manufacturing methodology of numerical control, CNC and DNC systems, advantages and applications |
|---|---|---|---|
| | C03 | M-506.3 | Write CNC part programming by using G codes and M codes and APT language |
| | C04 | M-506.4 | Explain material handling systems AGV and robots in CAM |
| | C05 | M-506.5 | Explain the importance and functions of FMS, CIMS, Rapid Prototyping and Reverse Engineering |

**Model Blue Print of the Question Paper**

| S. No | Chapter Name | Periods Allocated | Weightage Allocated | Marks Wise Distribution of Weightage | | | | Question Wise Distribution of Weightage | | | | CO's Mapped |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | R | U | Ap | An | R | U | Ap | An | |
| 1 | Introduction to Computer aided manufacturing | 07 | 09 | 03 | 03 | | | 1 | 1 | | | CO1, CO3, CO5 |
| 2 | NC, CNC and DNC Systems | 13 | 14 | 03 | 03 | 8 | | 1 | 1 | 1 | | CO3, CO4 |
| 3 | CNC programming | 14 | 18 | | 03 | 08 | 10 | | 1 | 1 | 1 | CO1, CO2, CO5 |
| 4 | Material handling systems of CAM | 10 | 14 | 03 | 03 | 08 | | 1 | 1 | 1 | | CO1, CO2, CO5 |
| 5 | Flexible Manufacturing Systems and Rapid prototyping | 16 | 25 | 03 | 06 | 16 | | 1 | 2 | 2 | | CO3, CO5 |
| | TOTAL | 60 | 80 | 12 | 18 | 40 | 10 | 04 | 6 | 05 | 01 | |

R-Remember;     U-Understanding;   Ap-Application ; An- Analylising

**Note: Higher order question may be given from Chapers 2 or 3.( here it is taken from chapter – 3)**

**Learning Outcomes:**
Upon completion of the course student shall be able to

**1.0. Introduction to Computer aided manufacturing (CAM)**

1.1. Explain the necessity of computer monitoring and control of manufacturing process

1.2. Define various computer aided manufacturing support functions viz.CAD, CADD, CAE, CAPP, CATD etc.

1.3. List six benefits of computer aided manufacture (CAM)

1.4. Explain the product cycle of a traditional manufacturing system and CAM system

1.5. Describe an integrated CAD/CAM,FMS and Computer Integrated Manufacturing Systems

1.6. State the concept, three advantages and three limitations of group technology

## 2.0. Numerical Control

2.1. Define1.Numerical control (NC) 2.Computer Numerical control (CNC) 3. Direct numerical control (DNC)

2.2. List the advantages, limitations and applications of NC manufacturing system in comparison to tradition manufacturing system

2.3. Explain the functions of three NC machine tool principal elements

2.4. Explain with a block diagram the manufacturing methodology of an NC system

2.5. Explain with illustrations the PTP, 1-axis, 2-axis, 3-axis numerical control modes

2.6. Illustrate a CNC machine tool and explain the functions of its principal elements

2.7. State the principal differences between NC and CNC systems

2.8. State three advantages of CNC systems over NC systems

2.9. Explain DNC system with a neat sketch

2.10. List three advantages and three applications of DNC

2.11. Compare NC, CNC and DNC systems

2.12. Explain the features and working of CNC-CMM

## 3.0. CNC Programming

3.1. Explain with a block diagram the various steps involved in developing a part program

3.2. Define manual part programming

3.3. Explain the syntax of each word in a block of a CNC program code in word address format as per ISO

3.4. Differentiate Geometry (G) from Miscellaneous (M) codes

3.5. Explain with syntax five popular G & M codes

3.6. Write a CNC program for a simple turning job in G & M codes

3.7. State the necessity of tool length and nose radius compensation in CNC programming

3.8. Define Computer aided part programming (CAPP)

3.9. State the advantages of CAPP over manual programming

3.10. Importance of APT among all popular CAPP languages

3.11. Illustrate with a block diagram the configuration of CAPP with APT

3.12. Explain the syntax of popular 1.Geometry statements, 2.Motion statements,3.post processor statements,4.compiler statements of APT language

3.13 Write a program in APT language for a simple drilling job from a given drawing

3.14. Name the commercially available GUI based CAPP languages and state their advantages over APT

## 4.0  Material handling systems in CAM

4.1. State the requirements of material handling systems in CAM

4.2. Differentiate between Primary and Secondary material handling systems

4.3. Define an automated guided vehicle (AGV)

4.4. Explain four types of AGVs with illustrations

4.5. State the applications of above  AGVs

4.6. Define a Robot

4.7. State the necessity of Robots in manufacturing environment

4.8. Explain various types of Robots with illustrations

4.9. Describe the functions of the Principal components of a Robot

## 5.0 Flexible manufacturing systems, CIMS & Rapid Prototyping

5.1. State the necessity of FMS

5.2. Explain the meanings of Machine flexibility, Production flexibility, Mix flexibility, Product flexibility, Routing flexibility, Volume flexibility, Expansion flexibility

5.3. Describe the layout of a typical FMS showing the principal components

5.4. Explain the functions of principal components of an FMS

5.5. State the features, advantages and applications of FMS

5.6. Illustrate design functions module, manufacturing functions module and Business functions module of a manufacturing system

5.7. State the necessity of integrating the various modules of a manufacturing system

5.8. Define CIMS

5.9. Describe CIMS showing the principal components

5.10. State the benefits of CIM

5.11 Define   Rapid Prototyping

5.12.  State any six the advantages of Rapid Prototyping

5.13. Classify Rapid Prototyping based on initial form of its material

5.14. Explain RP Techniques: Stereo Lithography (SLA), Selective Laser Sintering (SLS), Fused

Deposition Modelling (FDM), Three Dimensional Printing (3DP) and Laminated Object

Manufacturing (LOM) with a legible sketch.

5.15 Define Reverse Engineering

5.16 State any six reasons for Reverse Engineering a product or part.

5.17 Explain the process of Reverse Engineering with a flow diagram.

**CONTENTS:**

**1.0 Introduction to Computer aided manufacturing (CAM)**

Role of computers in manufacturing–Computer aided monitoring and control – computer aided manufacturing support functions viz. CAD, CADD,CAE, CAPP– Benefits of CAM - Product cycle in traditional and computerized manufacturing environments – linkage of various manufacturing functions through computerized database– Integrated CAD/CAM  -  Types of production systems –Transfer line production – Flexible manufacturing system – Standalone CNC system – features and applications of each type - Group Technology – advantages and limitations

**2.0   Introduction to NC, CNC and DNC systems.**

Introduction to NC -   advantages over conventional manufacturing system – Limitations – applications , Working principle of NC machine tool- elements of NC machine tool ,Manufacturing methodology of NC systems – Part drawing – Part program – Program tape – Tape reader – Controller – Machine tool, Numerical control modes – Point to point control – One axis control – Simultaneous two axes control – Simultaneous three axes control
 CNC and DNC systems - Working principle of CNC machine tool – major differences over NC systems – advantages over NC system, Direct Numerical control – concept – features – advantages –applications, Comparative treatment of NC, CNC, and DNC systems, CNC Co-ordinates measuring machine (CNC-CMM) – Principle of working – Principal components – features – advantages – applications

**3.0. CNC programming**

Steps involved in development of part program – Process planning –Axes nomenclature for CNC turning and machining centres – Tool selection – Cutting process parameters selection – Job and tool setup planning – Machine tool path planning – Part program writing – Part program verification, Manual part programming (as per ISO) – Word address format –meaning of each word – List of preparatory functions – List of miscellaneous functions , Tool length compensation – Nose radius compensation – Cutter radius compensation, Computer aided part programming (CAP) – advantages over manual part programming, List of Geometry, Motion, Post processor and Compiler commands used in APT, Sample programs for simple turning jobs in G & M codes, Sample programs in APT for simple Drilling jobs, Overview of commercially available GUI based CAP programming languages – advantages over APT language

**4. Material handling systems in CAM**

Material handling systems – functions in CAM environment – Primary and secondary systems – automated guided vehicle systems (AGVS), AGV types – Towing vehicles – Unit load vehicles – Pallet trucks – Fork trucks – Light load vehicles – Assembly line vehicles –  their applications, Robots –  areas of

application – types of robots, Layout of an industrial robot – functions of each component

## 5. Flexible manufacturing systems (FMS) and  Rapid Prototyping

Flexible manufacturing systems (FMS) :Different types of flexibilities – Machine flexibility – Production flexibility – Mix flexibility – Product flexibility – Routing flexibility – Volume flexibility – Expansion flexibility, Layout of a typical FMS showing principal components, Components of FMS – CNC machine centres – Features of FMS – advantages – applications
Computer Integrated Manufacturing Systems (CIMS)- Components of a manufacturing system – Design functions module – Manufacturing functions module – Business functions module – Necessity of Integration , Concept of CIM– Benefits of CIM
Rapid Prototyping –Definition, advantages and applications; Working Principle, Work flow of RP process; RP Techniques: Stereo Lithography (SLA), Selective Laser Sintering (SLS), Fused Deposition Modelling (FDM), Three Dimensional Printing (3DP) and Laminated Object Manufacturing (LOM); Reverse Engineering

## REFERENCE BOOKS

| 1 | Numerical Control and Computer Aided Manufacturing | T.K.Kundra,P.N.Rao | TMH |
|---|---|---|---|
| 2 | Computer Aided Manufacturing | T. K. Kundra, P.N. Rao | MGH Publishers |
| 3 | CAD/CAM | Groover and Zimmers | Pearson Education India |
| 4 | Rapid Prototyping | Chua C.K, Leong K.F ,Lim C.S | World Scientific Publishing Co.Pte.Ltd |

**Course Title**       :      **CAD/CAM LAB PRACTICE**
**Course Code**       :      **M–507**
**Periods per week**    :      **06**
**Period per semester**   :      **90**

## TIME SCHEDULE

| SI No. | PART – A - CAD Lab | |
|:---:|:---|:---:|
| | **Chapter/Unit Titles** | **No. of periods** |
| 1. | Introduction to CAD | 03 |
| 2. | Selecting commands & Working with drawing | 03 |
| 3. | Viewing drawing | 03 |
| 4. | Working with coordinates | 03 |
| 5. | Creating simple and complex entities | 03 |
| 6. | Getting Drawing information | 03 |
| 7. | Modifying entities | 03 |
| 8. | Working with text | 03 |
| 9. | Dimensioning drawing | 03 |
| 10. | 2D Drawing | 09 |
| 11. | Layers | 03 |
| 12. | 3D Drawings | 06 |
| | **TOTAL** | **45** |

## Course Objectives and Course Outcomes

| Upon completion of the course the student shall be able to | | |
|:---|:---|:---|
| **COURSE OBJECTIVES** | 01 | Know CAD screen and various tool bars and menus |
| | 02 | Apply dimensioning and hatching on the auto CAD drawings |
| | 03 | Draw 2D –drawings |
| | 04 | Draw 3D -drawings |
| **COURSE OUTCOMES** | CO1 | Demonstrate basic concepts of the CAD software |
| | C02 | Apply appropriate command to develop basic drawings |
| | C03 | Use edit and plotting techniques to manipulate drawings through editing and plotting technique |
| | CO4 | Draw 2D drawings for given specifications |
| | CO5 | Draw 3D drawings for given specifications |

## Learning Outcomes

**1.0  Understand about the Computer Aided Drafting and its software**
     1.1     Define Computer Aided Drafting
     1.2     List the Advantages of CAD
     1.3     Explain the importance of CAD software

1.4    Explain the evolution of Cad software up to parametric modelling and direct modelling
1.5    Explain the features of Graphic Work station
1.6    Use CAD Environment: Screen, Various tool bars and menus.

**2.0    Use appropriate selection commands**
2.1    Practice commands using toolbars, menus, command bar
2.2    Practice repeating a command, Nesting a command and modifying a command
2.3    Use prompt history window and scripts
2.4    Practice mouse shortcuts
2.5    Practice the Creating the drawing, Opening existing and damaged Files, saving the drawing
2.6    Practice the setting up a drawing
2.7    Practice the setting and changing the grid and snapping alignment
2.8    Practice the Entity snaps

**3.0    Use viewing tools of CAD**
3.1    Practice the use of Scroll bar, pan command, and rotating view to move around within drawing
3.2    Practice the changing of magnification of drawing
3.3    Practice the displaying of multiple views
3.4    Practice the use of controlling visual elements like Fill, Text, Blips and Line weight

**4.0    Use coordinate systems of the drawing**
4.1    Practice how the coordinate system work
4.2    Practice how the coordinate system displayed
4.3    Practice the Find tool to determine the coordinates of a point
4.4    Practice the Two dimensional coordinates such as Absolute Cartesian, Relative Cartesian and Polar coordinates
4.5    Practice the use of right-hand rule
4.6    Practice the how to enter into x, y, z - coordinates
4.7    Practice the Three dimensional coordinates such as Spherical and Cylindrical coordinates
4.8    Practice the use of filters in two and three dimensions
4.9    Practice defining user coordinate system
4.10   Practice the use of present user coordinate system

**5.0    Create the simple and complex entities**
5.1    Draw the lines, circles, arcs, ellipses, elliptical arcs, rays and infinite lines
5.2    Practice the Creation of point entities
5.3    Practice the Editing of point entities
5.4    Draw the complex shapes like Rectangles, Polygons, Polylines, Splines, Donuts, and Planes
5.5    Practice the adding of hatch pattern

**6.0    Use the drawing information retrieving tools Measure, Divide, Calculate, Display, and Track**
   6.1    Measure the intervals on entities
   6.2    Divide the entities in to segments
   6.3    Calculate the areas defined by points, of closed entities, and Combined entities
   6.4    Calculate the distance between the entities
   6.5    Calculate the angle between the entities
   6.6    Display the information about the entities and drawing status
   6.7    Track time spent working on a drawing

**7.0    Use the modifying tools to modify the properties of entities**
   7.1    Practice the entity selection and deselect ion methods
   7.2    Practice the Deletion of entities
   7.3    Practice the Copying of entities within a drawing, between drawings
   7.4    Practice the making of parallel copies, Mirroring entities and arraying entities
   7.5    Practice the Rearranging of entities by Moving, Rotating and Reordering
   7.6    Practice the Resizing of entities by Stretching, Scaling, Extending, Trimming, and Editing the length
   7.7    Practice the Braking and joining of entities
   7.8    Practice the creating, modifying the groups and ungrouping of Entities
   7.9    Practice the Editing of polylines: Opening, Closing, Curving, Decurving, Joining, Changing width and editing vertices
   7.10   Practice the Exploding of entities
   7.11   Practice the Chamfering and Filleting of entities

**8.0    Use the Text tool to create and formatting the various types of text fonts and its styles**
   8.1    Practice the creating, naming and modifying the text fonts
   8.2    Practice the Creation of line text, paragraph text
   8.3    Practice the Setting of line text style and its alignment
   8.4    Practice the Setting of Paragraph text style and its alignment
   8.5    Practice the Changing of line text and Paragraph text
   8.6    Practice the use of alternate text editor

**9.0    Use Dimensioning concepts to create dimensions, Edit dimensions, Control dimension styles & variables and Adding geometric tolerances**
   9.1    Practice the creating of linear, Angular, Diametral, Radial, Ordinate dimensions
   9.2    Practice the creating leaders and annotations
   9.3    Practice making dimensions oblique
   9.4    Edit the dimension text
   9.5    Practice the Controlling of dimension arrows and format
   9.6    Practice the Controlling of line settings and dimension text
   9.7    Practice the Controlling of dimension units, and dimension tolerance

## 10.0  Create 2D Drawing
10.1   Create 2D drawings of Knuckle Joint
10.2    Create 2D drawings of flange Coupling
10.3   Create 2D drawings of Footstep Bearing
10.4    Lathe Tool Post
10.5   Eccentric

## 11.0  Organize the information on layers
11.1   Practice the setting a current layer, layers color, line type, line weight, print style
11.2   Practice the locking and unlocking of layers
11.3   Practice the layer visibility and layer printing
11.4   Practice the setting of current line type
11.5   Practice the loading of additional line types
11.6   Practice the creating and naming of line type
11.7   Practice the editing of line type

## 12.0  3D Drawings
12.1    Explain the concept of 3D
12.2    Create 3D solids using solid tool bar options
12.3    Create 3D Drawings of Standard Mechanical Components (Bolt and Nut, Screw jack)
12.4    Practice of Rendering

## COURSE CONTENT

## 1.0  The Computer Aided Drafting and its software
Definition of Computer Aided Drafting, the Advantages and importance of CAD software, the features of parametric modelling and direct modelling, the features of Graphic Work station, CAD Environment: Screen, Various tool bars and menus.

## 2.0  Selection of commands
Commands using toolbars, menus, command bar. Repeating a command, Nesting a command and modifying a command. Use of prompt history window and scripts, mouse shortcuts. Creating the drawing. Opening existing and damaged files, saving of drawing, setting up a drawing. Setting and changing the grid and snapping alignment, and the Entity snaps.

## 3.0  Use of viewing tools of CAD
Use of Scroll bar, pan command, and rotating view to move around within drawing, changing of magnification of drawing. Displaying of multiple views, the use of controlling visual elements like Fill, Text, Blips and Line weight.

## 4.0  Use of coordinate systems of the drawing
Two dimensional coordinates such as Absolute, Cartesian, Relative Cartesian and Polar coordinates. The use of right-hand rule. Three dimensional coordinates such as Spherical and Cylindrical Coordinates, the use of filters in two and three dimensions, defining user Coordinate system.

**5.0    Creating simple and complex entities**
Drawing of lines, circles, arcs, ellipses, elliptical arcs, rays and infinite lines. Creating and editing of point entities. Drawing of complex shapes like rectangles, polygons, polylines, Splines, donuts, planes, and adding of hatch pattern

**6.0    Use the drawing information retrieving tools Measure, Divide, Calculate, Display, and Track**
Measuring the intervals on entities, dividing the entities into segments. Calculation of areas defined by points, closed entities, and combined entities, calculate the distance and angle between the entities. Displaying the information about the entities and drawing status. Tracking time spent working on a drawing.

**7.0    Use the Modifying tools to modify the properties of entities**
Entity selection and de selection methods, the Deletion of entities. Copying of entities within a drawing, between drawings, parallel copies, Mirroring entities and  Arraying entities. The Rearranging of entities by Moving, Rotating and Reordering. The Resizing of entities by Stretching, Scaling, Extending, Trimming, and Editing the length. The Braking and joining of entities. The creating, modifying the groups and Ungrouping of Entities. Editing of polylines: Opening, Closing, Curving, Decurving, Joining, Changing width and editing vertices, The Exploding of entities, the Chamfering and Filleting of entities

**8.0    Use the Text tool to create and formatting the various types of text Fonts and its styles**
The creating, naming and modifying the text fonts, the Creation of line text, paragraph text, setting of line text style and its alignment. The Setting of Paragraph text style and its alignment, the Changing of line. Text and Paragraph text, the use of alternate text editor.

**9.0    Use  Dimensioning concepts to create dimensions, Edit dimensions, Control dimension styles & variables and Adding geometric tolerances**
The creating of linear, Angular, Diametral, Radial, Ordinate dimensions. The creating leaders and annotations, making dimensions oblique, Editing the dimension text, controlling of dimension arrows and format. The Controlling of line settings and dimension text, the Controlling of dimension units, and dimension tolerance.

**10.0   2D Drawings**
Using appropriate commands creation of 2D drawings of standard mechanical components.

**11.0   Organize the information on layers**
Setting a current layer, layers color, line type, line Weight, print style Locking and unlocking of layers, the layer visibility and layer printing. Setting of current

line type.The loading of additional line types, creating and naming of line type, editing of line type.

## 12.0   3D Drawings
   3D drawings of standard components. Rendering of 3D images


**REFERENCE BOOKS**

4MCAD User Guide- IntelliCAD Technology Consortium (WWW.intellicad.org)
4MCAD Software:
1. 4MCAD Viewer,
2. 4MCAD Classic,
3. 4MCAD Standard,
4. 4MCAD Professional.


**TIME SCHEDULE**

| S.No | Chapter/Unit Titles | Periods |
|---|---|---|
| | **PART – B – CAM LAB** | |
| 1 | CNC Introduction | 3 |
| 2 | Study of turning | 3 |
| 3 | G–codes and M-codes | 3 |
| 4 | Simulation software practice | 6 |
| 5 | Structure of program | 6 |
| 6 | Turning exercise–step turning using canned cycle | 6 |
| 7 | Turning exercise–Circular interpolation CW, CCW | 6 |
| 8 | Turning Exercise-Taper turning and Peck drilling | 6 |
| 9 | Turning exercise–Thread cutting and grooving | 6 |
| | **Total** | **45** |

**Course Objectives and Course Outcomes**

| | | Upon completion of the course the student shall be able to |
|---|---|---|
| **COURSE OBJECTIVES** | 01 | Familiarise with parts and functions of CNC lathe |
| | 02 | Familiarise in writing the part programming using M-Codes and G-Codes and execute on CNC Lathe |
| **COURSE OUTCOMES** | CO1 | Demonstrate the parts and functions of a CNC lathe |
| | C02 | Practice incremental system and absolute system of dimensioning |
| | C03 | Write simple part program using G-Codes and M-Codes. |
| | C04 | Edit and execute a part program using CNC lathe machine simulation package. |
| | C05 | Produce part as per the drawing using CNC lathe machine. |

**Learning Out Comes:**

Upon completion of the course the student shall be able to

1. Demonstrate the parts and functions of CNC lathe
2. Explain incremental system and absolute system on dimensioning.
3. Write simple part program using G-Codes and M-Codes.
4. Edit and execute a part program using CNC lathe machine simulation package.
5. Prepare part program as per the drawing.
6. Produce part as per the drawing using CNC lathe machine.

**COURSECONTENT**

1. CNC Introduction
2. Study of turning.
3. G–codes and M-codes
4. Simulation software practice.
5. Structure of program.
6. Turning exercise–step turning using canned cycle.
7. Turning exercise–Circular interpolation CW, CCW.
8. Turning exercise-Taper turning and Peck drilling.
9. Turning exercise–Thread cutting and grooving.

# LIFE SKILLS LAB PRACTICE

| Course Code | Course Title | No. of Periods /Week | Total No. of Periods | Marks for FA | Marks for SA |
|---|---|---|---|---|---|
| M-508 | Life Skills Lab Practice | 3 | 45 | 40 | 60 |

| S. No. | Unit Title | No of Periods | COs Mapped |
|---|---|---|---|
| 1 | **Attitude** | **4** | CO1 |
| 2 | **Adaptability** | **4** | CO1, CO2 |
| 3 | **Goal Setting** | **4** | CO1, CO2, CO3 |
| 4 | **Motivation** | **4** | CO1, CO2, CO3 |
| 5 | **Time Management** | **4** | CO2 |
| 6 | **Critical thinking** | **4** | CO3 |
| 7 | **Creativity** | **4** | CO3 |
| 8 | **Problem Solving** | **5** | CO3 |
| 9 | **Team Work** | **4** | CO4 |
| 10 | **Leadership** | **4** | CO4 |
| 11 | **Stress Management** | **4** | CO4 |
| | **Total Periods** | **45** | |

| | |
|---|---|
| **Course Objectives** | To understand the importance of Life skills for acceptable, sustainable and ethical behaviour in academic, professional and social settings |
| | To exhibit language competence appropriate to acceptable social and professional behaviour. |
| | To demonstrate time management, stress management, team skills, problem solving ability to manage oneself in academic, professional and social settings. |

| CO No. | Course Outcomes |
|--------|-----------------|
| CO1 | Demonstrates positive attitude and be able to adapt to people and events |
| CO2 | Fixes personal and professional goals and manages time to meet targets |
| CO3 | Exhibits critical and lateral thinking skills for problem solving. |
| CO4 | Shows aptitude for working in teams in a stress free manner and sometimes/ very often/ mostly display leadership traits. |

**Blue Print for evaluation based on Course Outcomes for SA:**

Note: Every Activity based Question that focuses on COs and responses as exhibited through communication has to be given marks for the following parameters

- Clarity of Thinking as Exhibited through Content
- Features of Etiquette

**\*Rubric Descriptors 'Outstanding/ Very Good/ Good/ Satisfactory/ Poor' levels of Competence**

| Level of Competence | Parameters of Assessment | |
|---------------------|--------------------------|--|
| | **Clarity of thinking as exhibited through content** | **Features of etiquette** |
| **Outstanding 10** | **Thinking** is **extremely logical** and suggested course of action is **feasible** <br><br> Shows **creativity and uniqueness** <br><br> Exhibits **expert use of expression** (organizational devices and discourse markers) that denote clarity in thought. | Exhibits **courtesy to all most appropriately** with **confidence** |
| **Very Good 8/9** | **Thinking** is **clear and logical** <br><br> Suggested **course of action is feasible** <br><br> Shows **traces of creativity** <br><br> Exhibits **good expression** (organizational devices and discourse markers) that denote clarity in thought. | Exhibits **courtesy to all to a considerable level.** |
| **Good 6/7** | **Thinking is clear and logical most of the time**. Lacks creativity or out of the box thinking as expressed through content. | Exhibits **courtesy / politeness to an acceptable level.** |

| | | | | Has courtesy but often |
|---|---|---|---|---|
| Satisfactory 4/5 | **Thinking is logical**; However **expressing content is disjointed and disorganized.** | | | fumbles with language. |
| Poor 3 or less than 3 | **Thoughts** as expressed through content are **incoherent. Language skills are very limited.** | | | Fails to show courtesy to others. |

**Blue Print for evaluation based on Course Outcomes for SA of each student:**
**Note:   Marks are awarded for each student as per the Rubric descriptors.**

| S No. | Questions based on Course Outcomes | Periods Allocated for practical work | Max Marks | Poor >3 | Satisfactory 4 /5 | Good 6/7 | Very Good 8/9 | Outstanding 10 |
|---|---|---|---|---|---|---|---|---|
| 1 | Short presentation on GOALS with Timeline and Action Plan | 12 | 10 | | | | | |
| 2 | State what you will do in the given situation (Assesses adaptability and critical thinking skills, leadership, team skills ) | 12 | 10 | | | | | |
| 3 | In how many different and creative way can you use _____ (Object) other than its primary use | 8 | 10 | | | | | |
| 4 | What solutions can you think of for _____ problem? | 13 | 10 | | | | | |
| | **Total** | **45** | **60** | | | | | |

**Note: The marks that are awarded for the student for 40 to be increased proportionally for 60.**

**Learning Outcomes**

1. **Attitude Matters :**

    1.1 Understand the importance of positive attitude and the consequences of negative attitude.

    1.2 Demonstrate positive attitude in dealing with work-related issues and in personal life.

2. **Adaptability….makes life easy :**

2.1 Understand the significance of adaptability.

2.2 Show adaptability whenever needed, both at place of work and on personal front.

**3. Goal Setting … life without a Goal is a rudderless boat!**

3.2 Understand the SMART features of goal-setting.

**3.3** State one's short-term and long-term goals and spell out plans to achieve them.

**4. Motivation … triggers success!**

4.2 Comprehend the need for motivation in order to achieve success in life.

4.3 State how one is motivated in life.

4.4 Show the impact of motivation on one's life

**5. Time Management… the need of the Hour!**

5.2 Understand the value of time management and prioritizing in life

5.3 Demonstrate the effect of time management on one's professional work.

**6. Critical Thinking … logic is the key!**

6.1 Distinguish between facts and assumptions

6.2 Use logical thinking in dealing with professional matters

**7. Creativity … the essential you!**

7.2 Understand the importance of thinking out of the box in dealing with critical issues

7.3 Solve problems using creativity / imagination

**8. Problem Solving … there is always a way out!**

8.2 Understand the need for and importance of problem solving.

8.3 Use logic or creativity to solve a problem at workplace or home.

**9. Team Work… together we are better!**

9.1 Understand the need for team skills / team building

9.2 Demonstrate one's skills as a team player

**10. Leadership… the meaning of a leading!**

10.1    Understand the need for team skills / team building

10.2    Demonstrate one's skills as a team player

**11. Stress Management… live life to the full!**

11.1 Understand what causes stress and how to cope with stress at workplace.

11.2 Demonstrate how stress can be overcome in a healthy way.

# REFRIGERATION AND AIR CONDITIONING LAB PRACTICE

| Course Title | Course Code | Periods per Week | Periods per Semester |
|---|---|---|---|
| Refrigeration and Air Conditioning Lab Practice | M – 509 | 03 | 03 |

## TIME SCHEDULE

| S.No | Chapter/Unit Title | Periods |
|---|---|---|
| 1 | Perform basic fabrication operations viz., flaring, swaging, bending and brazing on soft copper tubes | 9 |
| 2 | Evaluate the C.O.P of a given Vapour Compression cycle test rig | 3 |
| 3 | Evaluate the C.O.P of a Domestic Refrigerator | 3 |
| 4 | Evaluate the C.O.P of a water cooler | 3 |
| 5 | Evaluate the C.O.P of Ice Plant | 3 |
| 6 | Perform various types of leak detection methods of a refrigeration system | 9 |
| 7 | Evaluate the C.O.P. of given air-conditioning system | 3 |
| 8 | Apply the method of vacuumization and refrigerant charging for a given vapour compression system. | 6 |
| 9 | Study of Window Air Conditioning System & Summer Air Conditioning system | 6 |
| | **Total** | **45** |

## Course Objectives and Course Outcomes

| Upon completion of the course the student shall be able to | | | |
|---|---|---|---|
| **COURSE OBJECTIVES** | 01 | | Familiarisation with R & AC tools and perform the basic operations on soft copper tube |
| | 02 | | Conduct performance test on Vapour Compression Refrigeration test rig, Domestic Refrigerator, Water Cooler, Ice Plant and Air condition Test Rig |
| | 03 | | Detect the Leakage of Refrigerant and vacuumization and refrigerant charging for a given vapour compression system. |
| **COURSE OUT COMES** | CO1 | M-509.1 | Explain various tools used in Refrigeration & Air Conditioning |
| | C02 | M-509.2 | Conduct the performance test and evaluate the COP of Vapour Compression Refrigeration test rig, Domestic Refrigerator, Water Cooler, Ice Plant. |
| | C03 | M-509.3 | Calculate the COP of a given Air condition Test Rig. |
| | C04 | M-509.4 | Conduct the vacuumization and refrigerant charging for a given vapour compression system. |
| | C05 | M-509.5 | Describe Window Air Conditioning System |

**Learning Objectives**:
Upon completion of the course the student shall be able to

**1.0. Perform basic fabrication operations viz., flaring, swaging, bending and brazing on soft copper tubes**

1.1. Identify various tools used in Refrigeration & Air Conditioning

1.2. Perform flaring, swaging, bending and brazing operations by using Refrigeration & Air conditioning tools.

**2.0. Evaluate the C.O.P of a given Vapour Compression cycle test rig**

2.1. Identify the components of vapour compression system

2.2. Record the values of pressure and temperature when the pressure gauges are stabilized

2.3. Record the energy meter reading

2.4. Read the values from Pressure Vs Enthalpy diagram of the given refrigerant

2.5. Evaluate actual, theoretical and relative C.O.P

**3.0. Evaluate the C.O.P of a Domestic Refrigerator**

3.1  Identify the components

3.2  Record the values of pressure and temperature when the Pressure gauges are stabilized

3.3  Record the energy meter reading

3.4  Read the enthalpy values from Pressure Vs Enthalpy diagram of the given refrigerant

3.5  Evaluate actual, theoretical and relative C.O.P

**4.0. Evaluate the C.O.P of a water cooler**

4.1  Identify the components

4.2  Record the values of pressure and temperature when the Pressure gauges are stabilized

4.3  Record the energy meter reading

4.4  Read the enthalpy values from Pressure Vs Enthalpy diagram of the given refrigerant

4.5  Evaluate actual, theoretical and relative C.O.P

**5.0. Evaluate the C.O.P of Ice Plant**

5.1  Identify the components

5.2  Record the values of pressure and temperature when the Pressure gauges are stabilized

5.3  Record the energy meter reading

5.4  Read the enthalpy values from Pressure Vs Enthalpy diagram of the given refrigerant

5.5  Evaluate actual, theoretical and relative C.O.P

**6.0.  Identify various types leak detection methods of a refrigeration system**

6.1  Detect the leakages of given vapour compression refrigeration system by using soap solution method.

6.2  Apply the methods of arresting leakages

6.3      Arrest the leakages if any by soldering

## 7.0. Evaluate the C.O.P. of given air-conditioning system

7.1      Identify the components of given vapour compression air-conditioning test rig.

7.2      Insert thermometers in suction line and discharge line

7.3      Run the given V.C. A.C. system for some time

7.4      Record the pressure and temperature readings when the pressure gauges are stabilized.

7.5      Record the energy meter reading

7.6      Read the enthalpy values from Pressure Vs Enthalpy diagram of the given refrigerant

7.7      Evaluate C.O.P

## 8.0. Apply the method of vaccumization and refrigerant charging for a given vapour compression system.

8.1      Evacuate the given V.C.R. system using a vacuum pump

8.2      Charge the given V.C.R. system by using suitable refrigerant gas

8.3      Run the system for at least 15 min. and check for the build-up of pressure in the pressure gauge.

## 9.0. Study of Window Air Conditioning System

9.1      Identify the components of given window A/C

9.2      Understand the functions of the components

9.3      Understand the maintenance procedure and remedies to the common problems encountered.

# PROJECT WORK

| Course Title | Course Code | Periods per Week | Periods per Semester |
|---|---|---|---|
| PROJECT WORK | M – 510 | 03 | 45 |

| | Upon completion of the course the student shall be able to | |
|---|---|---|
| **Course Objectives** | | • Enhance the knowledge by field visits<br>• Provide with the opportunity to synthesize knowledge from various areas of learning<br>• Critically and creatively apply it to real life situations |
| **COURSE OUT COMES** | CO1 | To demonstrate team work, sprit and self-confidence |
| | CO2 | To work independently. |
| | CO3 | To Apply theory to practical work situations. |
| | CO4 | To prepare technical reports. |

**Learning Outcomes**
Upon completion of the course the student shall be able to

**1.0 Problem solving and Critical Thinking**
  1.15. Generate Ideas from mechanical courses.
  1.16. Develop these Ideas.
  1.17. Gather relevant Information.
  1.18. Evaluate Ideas.
  1.19. Apply these ideas to a specific task.
  1.20. Execute appropriate Laboratory skills
  1.21. Draw Appropriate Conclusions

**2.0 Communication**
.    2.1 Communicate effectively.
  2.2 Present Ideas Clearly.
  2.3 Present Ideas Coherently.
  2.4 Report writing

**3.0    Collaboration**
  3.1. Discuss the ideas.
  3.2 Coordinate with team members
  3.3. Team work in accomplishing the task.

**4.0    Independent Learning**
  4.1. Involves in the group task.

  4.3. Analyze the appropriate actions.

  4.4. Compares merits and demerits
  4.5. Analyze the activities for sustainability.

4.6 Analyze the activities to ensure ethics

**5.0 Ethics**

5.1 Give respect and value to all classmates, educators, colleagues, and others

5.2 Understand the health, safety, and environmental impacts of their work

5.3 Recognize the constraints of limited resources

5.4 Develop sustainable products and processes that protect the health, safety, and prosperity of future generations

5.5 Maintain integrity in all conduct and publications and give due credit to the contributions of others

## COURSE CONTENT

1.0 Design/Fabrication/Analysis/ Case Study Projects in the areas of Mechanical Engineering and other related areas

**Weightage of marks for Assessment of Learning Outcomes of Project work**

| S.No | Item | Marks |
|------|------|-------|
| 1 | **Internal Marks** Demonstration of Assigned task in the group to complete the project | 40 |
| | **End Exam Marks: Demonstration of skill relevant to the project (30) Project Report(20) Viva Voce(10)** | 60 |
| **Total marks** | | **100** |

➢ End Examination assessment shall be done by both internal, external examiners and faculty members who guided the students during project work.

# VI SEMESTER

# INDUSTRIAL TRAINING

**Course Title** : **Industrial Training**
**Course Code** : **M-601**
**Duration** : **6 months**

**Time schedule**

| S.NO | Code | TOPICS | Duration |
|---|---|---|---|
| 1 | M-601 | • Practical training in Industry<br>• Training Report Preparation<br>Report Preparation: Title Page, Certificate, Acknowledgements, Abstract, Contents(introduction of Industry, Plant Layout, Organization Chart, List of Major Equipment's, List of Processes: Skills Acquired; Conclusions; References | Six Months |

## Course Objectives and Course Outcomes

| Upon completion of the course the student shall be able to | | |
|---|---|---|
| **Course Objectives** | | 1.Expose to real time working environment<br>2. Enhance knowledge and skill already learnt in the institution.<br>3. Acquire the required skills of manufacturing processes, assembling, servicing, supervising in the engineering fields.<br>4. Install the good qualities of integrity, responsibility and self-confidence. |
| **COURSE OUT COMES** | CO1 | Apply theory to practical work situations |
| | CO2 | Cultivate sense of responsibility and good work habits |
| | CO3 | Exhibit the strength, teamwork spirit and self-confidence |
| | CO4 | Write report in technical projects |

## PO-CO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | | | | 2 | | 1 | 3 | | 2 |
| CO2 | | | | | | 3 | | 3 | | 2 |
| CO3 | | | | | | 3 | | 3 | | 2 |
| CO4 | | | | | | 3 | | 3 | | 2 |

**3: High, 2: Moderate,1: Low**

## Learning Outcomes
The student shall be able to display the following skill sets
1) Technical Skills *(*Manufacturing/Service/Drafting/Maintenance etc)
2) Reading drawings and analysing Specifications
3) Recognize and Practice safety Measures

4) Handling Tools/Instruments/Materials/Machines
5) Assess and Control of quality parameters
6) Planning, Organizing and recording Skills

*Scheme of Evaluation*

| Sl. No. | Course | Duration | Scheme of Evaluation | | |
|---|---|---|---|---|---|
| | | | Assessment | Nature | Max. Marks |
| 1 | Industrial Training | 6 months | 1.First Assessment at Industry (After 12 Weeks) | Assessment of Learning outcomes by both the faculty and training Mentor of the industry | 120 |
| | | | 2.Second Assessment at the Industry (After 22 weeks) | Assessment of Learning outcomes by both the faculty and training Mentor of the industry | 120 |
| | | | Final Summative assessment at institution level | Training Report | 20 |
| | | | | Demonstration of any one of the skills listed in learning outcomes | 30 |
| | | | | Viva Voce | 10 |
| | | | | TOTAL MARKS | 300 |

*Weightage of marks for Assessment of Skill sets during first and second assessment.*

| Skill Set Sl.No | SKILL SET | Max Marks Allotted For each parameter |
|---|---|---|
| 1 | Technical Skills | 15 |
| 2 | Reading drawings and analysing Specifications | 20 |
| 3 | Handing Tools / Safety Practices | 15 |
| 4 | Trouble Shooting of the unit | 30 |
| 5 | Quality Assessment and Control | 15 |
| 6 | Soft Skills and recording Skills | 25 |
| | Total | 120 |

During assessment the performance of the students shall be assessed in those skills in which the student has been trained and be awarded the marks as per the weightage assigned as above. In case the student has undergone training in a few skill sets then the total marks obtained shall be raised to 120 marks for the given assessment i.e. either assessment 1 or 2. However the performance of the student shall be assessed at the most skill sets listed above but not less than three skill sets.

**Illustration**

If the student has undergone training in only 4 skill sets (namely serial number 1, 3, 4, 5 of above skill sets) and marks awarded during assessment is 50 out of 80 marks, then the marks of 50 shall be enhanced to 120 proportionately as (50/80)*120=75.

**GUIDELINES FOR INDUSTRIAL TRAINING**

1. Duration of the training: 6 months.
2. Eligibility: The As per SBTET norms
3. Training Area: Students may be trained in the fields Fabrication/Foundry/Manufacturing/Service/Drafting/Maintenance etc.
4. The candidate shall put a minimum of 90% attendance during Industrial Training.
5. If the student fails to secure 90% attendance during industrial training, the student shall reappear for 6 months industrial training.
6. Formative assessment at industry level shall be carried out by the Mentor from of the industry, where the student is undergoing training and the faculty in charge (Guide) from the concerned section in the institution.
7. The Industrial training shall carry 300 marks and pass marks is 50% in assessments at industry (first and second assessment) and final summative assessment at institution level put together i.e. 150 marks out of 300 marks.
8. If the student fails to secure 50% marks in final summative assessment at institution level, the student should reappear for final summative assessment in the subsequent board examination.
9. Final summative assessment at institution level is done by a committee including 1. Head of the section (of **concerned discipline ONLY**), 2. External examiner from an industry and 3. Faculty member who assessed the student during Industrial Training as members.

**Guidelines and responsibilities of the faculty members who are assessing the student's performance during industrial training:**

➢ Shall guide the students in all aspects regarding training.
➢ Shall create awareness regarding safety measures to be followed in the industry during the training period, and shall check it scrupulously.
➢ Shall check the logbook of the students during the time of their visit for the assessment.
➢ Shall monitor progress at regular intervals and make appropriate suggestions for improvement.
➢ Shall visit the industry and make first and second assessments as per stipulated schedules.
➢ Shall assess the skill sets acquired by the students during their assessment.
➢ Shall award the marks for each skill set as per the marks allotted for that skill set during 1st and 2nd assessments
➢ Shall voluntarily supplement students learning through appropriate materials like photographs, articles, videos etc.
➢ Shall act as co-examiner along with other examiners in the final assessment at institution.
➢ Shall act as liaison between the student and mentor.

- ➤ Shall maintain a diary indicating his observation with respect to the progress of students learning in all three domains (Cognitive, Psychomotor and Affective).

**Guidelines to the training mentor in the industry:**
- ➤ Shall train the students in all the skill sets as far as possible.
- ➤ Shall assess and award the marks in both the assessments along with the faculty member.
- ➤ Shall check and approve the log books of the students.
- ➤ Shall approve the attendance of each student at the end of the training period.
- ➤ Shall report to the guide about student's progress, personality development or any misbehavior as the case may be.
- ✓ **Every Teacher (including HoD if not holding any FAC) shall be assigned a batch of students of 10 to 15 for industrial training irrespective of student's placements for training.**

## Rubrics for Industrial Training Assessment

## Department of Technical Education

**Name of the Institution/ College:**

**PIN:**                          **Name of the student:**

| Skill Set Sl. No | SKILL SET | Max Marks Allotted For each parameter | Precisely completes the task | Completes the task, mistakes are absent, but not Precise | Completes the task, Mistakes are a few | Makes attempt, Mistakes are many |
|---|---|---|---|---|---|---|
| 1 | **Technical Skills (15 M)**<br>(i) Analytical Thinking<br>(ii) Creativity.<br>(iii) Problem-solving. | 5<br>5<br>5 | 5<br>5<br>5 | 3<br>3<br>3 | 2<br>2<br>2 | 1<br>1<br>1 |
| 2 | **Reading Drawings and Analysing Specifications ( 20 M)**<br>(i) 2 D and 3D (Computer Aided Design) CAD.<br><br>(ii) Knowledge of specifying the machine member | 10<br><br>10 | 10<br><br>10 | 7<br><br>7 | 6<br><br>6 | 3<br><br>3 |
| 3 | **Handling Tools / Instruments / Safety Practices  (15 M)**<br> (i)  Identification of tools and instruments.<br> (ii) Measuring the parameter<br>(iii) Aware of  safety Management | 5<br><br>5<br><br>5 | 5<br><br>5<br><br>5 | 3<br><br>3<br><br>3 | 2<br><br>2<br><br>2 | 1<br><br>1<br><br>1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 4 | **Trouble Shooting / Dismantling & Assembling and of the Unit (30 M)** | | | | | |
| | (i) Fault-Finding | 5 | 5 | 3 | 2 | 1 |
| | (ii) Dismantling the given Machine/ Equipment / Engine | 10 | 10 | 7 | 6 | 3 |
| | (iii) Repair or Replacement with spare parts | 5 | 5 | 3 | 2 | 1 |
| | (iv) Assembling of the given Machine/ Equipment / Engine after testing for working condition. | 10 | 10 | 7 | 6 | 3 |
| 5 | **Quality Assessment and Control ( 15 M)** | | | | | |
| | (i) Use of various Inspection and Quality Control Tools | 5 | 5 | 4 | 3 | 2 |
| | (ii) Identification of Proper Testing Method and Tool for the manufactured Components | 5 | 5 | 4 | 3 | 2 |
| | (iii) Analyse Test Results | 5 | 5 | 4 | 3 | 2 |
| 6 | **Soft skills and Recording skills(25 M)** | | | | | |
| | (i)Communication Skills (oral/writing skills) | 5 | 5 | 4 | 3 | 2 |
| | (ii) Human relations. | 5 | 5 | 4 | 3 | 2 |
| | (iii) Supervisory abilities. | 5 | 5 | 4 | 3 | 2 |
| | (iv) Recording technical issues | 5 | 5 | 4 | 3 | 2 |
| | (v) Proper Maintenance of records in the industry. | 5 | 5 | 4 | 3 | 2 |

*Mistakes are with reference to Technique, Procedure & Precautions, while precision refers to Technique, Procedure, Precautions, Time & Result

**Total Marks: 120**
Marks Awarded: _____
(Marks awarded in words:                    )


Signature of the Training In-charge          Signature of the faculty in-charge (Guide)
(Mentor)                                      Name
Name                                         Designation
Designation


E N D