

**CURRICULUM-2009  
(C-09)**

**DIPLOMA IN  
MECHANICAL ENGINEERING**

**State Board of Technical Education & Training  
Andhra Pradesh  
HYDERABAD**

## INDEX

<b>Sno</b>	<b>Particulars</b>	<b>Page Number</b>
1	Preamble	
2	Scheme of Instructions & Examination - I Year	
3	Scheme of Instructions & Examination - III Semester	
4	Scheme of Instructions & Examination - IV Semester	
5	Scheme of Instructions & Examination - V semester	
6	Scheme of Instructions & Examination - VI Semester	

### I-YEAR

<b>Sno</b>	<b>Sub Code</b>	<b>Name of the subject</b>	<b>Page Number</b>
1	M-101	English -I	
2	M-102	Engineering Mathematics - I	
3	M-103	Engineering Physics	
4	M-104	Engineering Chemistry and Environmental Studies	
5	M-105	Workshop Technology	
6	M-106	Workshop Practice - I	
7	M-107	Engineering Drawing	
8	M108	Physics Laboratory	
9	M-109	Chemistry Laboratory	
10	M-110	Information Technology lab	

### III Semester

<b>Sno</b>	<b>Sub Code</b>	<b>Name of the subject</b>	<b>Page Number</b>
1	M-301	English -II	
2	M-302	Engineering Mathematics -II	
3	M-303	Engineering Mechanics	
4	M-304	Electrical Engg & Basic Electronics	
5	M-305	Thermal Engineering-I	
6	M-306	Manufacturing Technology -I	
7	M-307	Machine Drawing	
8	M-308	Mechanical Engg. Lab	
9	M-309	Electrical Engg Lab	
10	M-310	CAD Lab- I	
11	M-311	Workshop Practice - II	

#### IV Semester

Sno	Sub Code	Name of the subject	Page Number
1	M-401	English-III	
2	M-402	Manufacturing Technology-II	
3	M-403	Strength of Materials	
4	M-404	Engineering Materials	
5	M-405	Thermal Engineering-II	
6	M-406	Hydraulics & Fluid Power systems	
7	M-407	Production Drawing	
8	M-408	Workshop Practice-III	
9	M-409	Material Testing Laboratory	
10	M-410	Hydraulics &Hydraulic Machines Lab	

#### V Semester

Sno	Sub Code	Name of the subject	Page Number
1	M-501	Industrial Training (Practical training)	

#### VI Semester

Sno	Sub Code	Name of the subject	Page Number
1	M-601	English -IV	
2	M-602	Industrial Management and Entrepreneurship	
3	M-603	Industrial Engineering & Estimating and costing	
4	M-604	CAD/CAM	
5	M-605	Design of Machine Elements	
6	M-606	ELECTIVES	
		(A) Refrigeration & Air Conditioning	
		(B) Automobile Engineering	
		(C) Energy sources & Power plant Engineering	
7	M-607	CAD Lab - II	
8	M-608	CAM Lab	
9	M-609	Thermal Engineering Lab	
10	M-610	R&A/C Laboratory	
11	M-611	Workshop Practice-IV	
12	M-612	Servicing and Maintenance lab	
13	M-613	Project work	

## **CURRICULUM (C-09) FOR DIPLOMA COURSES IN ANDHRA PRADESH**

### **Preamble**

The State Board of Technical Education and Training, Andhra Pradesh under the aegis of the Department of Technical Education, Andhra Pradesh generally reviews the Curricula once in every five years. However, recognizing the changing needs as stated by the user industries, the board has decided to bring forward the revision of curriculum by a year. Consequently, the Board with the assistance of the faculty made a thorough assessment of the curricular changes that have to be made. It was felt that there is an urgent need to improve hands-on experience among the students pursuing diploma courses. Further, the urgency of enhancing communication skills in English was also highlighted in the feedback and suggestions made by the user industries. Keeping these in view, a number of meetings and deliberations were held at district and state level, with experts from industry, academia and senior faculty of the department. The new Curricula for the different diploma courses have been designed with the active participation of the members of the faculty teaching in the Polytechnics of Andhra Pradesh. This will be implemented from the academic year 2009-10.

The primary objective of the curricular change is to produce best technicians in the country by correlating growing needs of the industries with the academic input.

### **Salient Features:**

1. Duration of course is modified from 3 years of academic instruction to 2½ years of academic instruction and 6 months of industrial training
2. Every student will get the benefit of Exposure to industry, hands on training; understand the industrial environment and the behavioural pattern while working in an industry.
3. The Curriculum is prepared on Semester Pattern sandwiched with One semester of Industrial Training at 5<sup>th</sup> Semester level. However, First Year is maintained as Year-wise pattern.
4. The policy decisions taken at the State and Central level are implemented with regard to environmental science by including relevant topics in Chemistry. This is also in accordance with the Supreme Court guidelines issued in Sri Mehta's case.
5. 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 and writing skills in English. Further as emphasized in the meetings, teaching of the language has been spread over all the three years of the course and special emphasis is also on areas of employability skills.
6. Advanced topics not relevant at diploma level of education are deleted.
7. Modern topics relevant to the needs of the industry and global scenario suitable to be taught at Diploma level are incorporated in the curriculum.
8. AutoCAD specific to the branch has been given more emphasis in the curriculum. Preparing drawings using Computer has been given more importance using CAD softwares

9. Every student is exposed to the computer lab at the 1<sup>st</sup> year stage itself in order to familiarize him with skills required for keyboard/mouse operation, internet usage and e-mailing.
10. The number of teaching hours allotted to a particular topic/chapter has been rationalized keeping in view the past experience
11. Elective subjects have been introduced at the 6<sup>th</sup> semester stage to enable to study certain subjects of importance/specialization.
12. Upon reviewing the existing C-05 curriculum, it is found that the theory content is found to have more weightage than the Practical content. In the revised C-09 curriculum, more attention is given to the practical content of Laboratories and Workshops, thus strengthening the practical side. Industrial Training has been introduced for One full semester to impart Practical Experience during the course of study itself.
13. With increased emphasis for the student to acquire Practical skills, the course content in all the subjects is thoroughly reviewed. While the course content in certain subjects is reduced, in rest of the subjects the content has been enhanced as per the need of the hour.
14. All Practical subjects are independent of each other and the practice of grouping two or more practical subjects is dispensed with.
15. Curricula of Laboratory and Workshops have been thoroughly revised basing on the suggestions received from the industry, faculty, for better utilization of the equipment available at the Polytechnics. The experiments /exercises that are chosen for the practical sessions are identified to confirm to the field requirements of industry.
16. Industrial Training introduced in V semester is aimed at promoting working in groups/Team building skills through '*practice-oriented, project based activities*'. This helps the student in interacting with people in better interaction of students with Industries, R & D Institutions and other developmental/promotional agencies.
17. The Members of the working group are grateful to Sri L.Prem Chandra Reddy, I.A.S., Commissioner of Technical Education & Chairman, S.B.T.E.T. and Sri Somesh Kumar, I.A.S., for their guidance and valuable inputs in revising, modifying and updating the curriculum.
18. The Members acknowledge with thanks the cooperation and guidance provided by Sri. P.T. Prabhakar, who was Secretary, State Board of Technical Education and Training, A.P., and Sri. G.V.Ranganath Secretary SBTET and other officials of Directorate of Technical Education and the State Board of Technical Education, A.P, experts from industry, academia from the universities and higher learning institutions and all teaching fraternity from the Polytechnics who are directly and indirectly involved in preparation of the curricula.

**RULES AND REGULATIONS FOR DIPLOMA COURSES**  
**UNDER THE CURRICULUM – 2009 (C-09)**

**1. DURATION AND PATTERN OF THE COURSES**

All the Diploma programs run at various institutions are of either 3 years or 3½ years duration, with Industrial Training of 6 months / one year, sandwiched between two Semesters 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. For all conventional branches, the Industrial Training is placed in the fifth semester. For all other courses, the training will be in the fifth & sixth semesters, and seventh semester will be at the institution. In respect of few courses like Diploma in Electronics with specialization in CP/ CN/ IE/ TV/ BM/ Embedded systems, the training will be in the seventh semester.

**2. PROCEDURE FOR ADMISSION IN TO THE DIPLOMA COURSES:**

- a) Selection of candidates is governed by the Rules and regulations lay down in this regard from time to time.
- b) Candidates who wish to seek admission in any of the Diploma courses will have to appear for common entrance examination (CEEP) conducted by the State Board of Technical Education and Training, Andhra Pradesh, Hyderabad.
- c) Only the candidates satisfying the following requirements will be eligible to appear for the Common Entrance Examination (CEEP).
- d) The candidates seeking admission should have appeared for the X class examination, conducted by the Board of Secondary Examination, Andhra Pradesh or equivalent examination thereto, at the time of making application to the Common Entrance Examination for Polytechnics (CEEP). In case candidates who apply pending results of their qualifying examinations, their selection shall be subject to production of proof of their passing the qualifying examination in one attempt or compartmentally at the time of interview for admission.
- e) Admissions are made based on the merit obtained in the Common Entrance Examination (CEEP) and the reservation rules stipulated by the Government of Andhra Pradesh from time to time.
- f) For admission into the following Diploma Courses for which entry qualification is 10+2, candidates need not appear for CEEP. A separate notification will be issued for admission into these courses.
  - 1). D.H.M.C.T. 2). D.Pharmacy

**3. MEDIUM OF INSTRUCTION**

The medium of instruction and examination shall be English.

**4. NUMBER OF WORKING DAYS PER SEMESTER / YEAR:**

- a). The Academic year for all the Courses shall be from Fifteenth June of the year of admission to the 31<sup>st</sup> March of the succeeding year.
- b). The Working days in a week shall be from Monday to Saturday
- c). There shall be 7 periods of 50 minutes duration 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 cover up the curriculum.

## 5. ELIGIBILITY OF ATTENDANCE TO APPEAR FOR THE END EXAMINATION

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.

Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester or 1<sup>st</sup> year may be granted on medical grounds.

Candidates having less than 65% attendance shall be detained.

Students whose shortage of attendance is not condoned in any semester / 1st year 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 / 1<sup>st</sup> year when offered next.

A stipulated fee shall be payable towards condonation of shortage of attendance.

## 6. READMISSION

Readmission shall be granted to eligible candidates by the respective RJD's / Principals

Within 15 days after commencement of class work in any semester (Except industrial Training)

Within 30 days after commencement of class work 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, after readmission is granted.

## 7. SCHEME OF EXAMINATION

THEORY EXAMINATION: Each Subject carries 80% marks with examination of 3 hours duration, along with 20% marks for internal evaluation. (Sessional marks). However, there are no minimum marks prescribed for sessionals.

PRACTICAL EXAMINATION: There shall be 40% Marks for regular practical work done, i.e. sessional marks for each practical subject with an end examination of 3 hours duration carrying 60% marks. However, there are no minimum marks prescribed for sessionals.

## 8. INTERNAL ASSESSMENT SCHEME

Theory Subjects: Theory Subjects carry 20% sessional marks. Internal examinations will be conducted for awarding sessional marks on the dates specified. Four unit tests will be conducted for I year students and two for semesters. Average marks obtained in all the tests will be considered for awarding the sessional marks.

Practicals: Student's performance in Laboratories / Workshop shall be assessed during the year of study for 40% marks in each practical subject. Allotment of marks should be discrete taking into consideration the students skills, accuracy, recording and performance of the task assigned to him / her. Each student has to write a record / log book for assessment purpose. In the subject of Drawing, which is also considered as a practical paper, the same rules hold good. Drawing exercises are to be filed in seriatum.

Internal assessment in Labs / workshops / Survey field etc., during the course of study shall be done and sessional marks awarded by Lecturer / Senior Lecturer / Workshop superintendent as the case may be.

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 the department preferably choosing a person from an Industry. Internal examiner shall be the person concerned with internal assessment as in (c) above. For drawing the end examination shall be held along with all theory papers.

Question Paper for Practicals: Question paper should cover all the experiments / exercise prescribed.

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

In case of Industrial Training, the training assessment shall be done and marks be awarded in the following manner. A final decision in this regard would be taken before the end of Academic Year 2009-10.

Industrial assessment	:	200 marks ( in Three spells )
Maintenance of log book	:	30 marks
Training Report	:	30 marks
Seminar / viva-voce	:	40 marks
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TOTAL	:	300 marks
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The assessment at the institute level will be done by a minimum of three faculty members including H.O.D. and be averaged.



## 9. MINIMUM PASS MARKS

**THEORY EXAMINATION:** For passing a theory subject, 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 subject, a candidate has to secure, a minimum of 50% in end examination and a combined minimum of 50% of both sessional and practical 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 subjects of D.C.C.P course.

## 10. PROVISION FOR IMPROVEMENT

- a) Improvement is allowed only after he / she has completed all the subjects from First Year to Final semester of the Diploma.
- b) Improvement is allowed in any 4 (Four) subjects of the Diploma.
- c) The student can avail of this improvement chance only once, that too within the succeeding two examinations after the completion of Diploma, with the condition that the duration including betterment examination shall not exceed FIVE years from the first admission.
- d) No improvement is allowed in Practical / Lab subjects or Project work or Industrial Training assessment. However, improvement is allowed in drawing subject.
- e) If improvement is not achieved, the marks obtained in previous Examinations hold good.
- f) Improvement is not allowed in respect to the candidates who are punished under Mal-practice in any Examination.
- g) Examination fee for improvement shall be paid as per the notification issued by State Board of Technical Education and Training from time to time.
- h) 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.

## 11. RULES OF PROMOTION FROM 1<sup>ST</sup> YEAR TO 3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup>, 6<sup>th</sup> and 7<sup>th</sup> SEMESTERS:

### For Diploma Courses of 3 years duration

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 upto 10%) i.e. attendance after condonation on Medical grounds should not be less than 65% and pay the examination fee.

A candidate shall be promoted to 3<sup>rd</sup> 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<sup>rd</sup> semester.

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  
Puts the required percentage of attendance in the 4<sup>th</sup> semester  
Should not have failed in more than Four backlog subjects of 1<sup>st</sup> year

A candidate shall be promoted to 5<sup>th</sup> semester (Industrial Training) 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 5<sup>th</sup> semester Industrial Assessment, if he/she

Puts the required percentage of attendance( 90%) in 5<sup>th</sup> semester and  
Should have obtained the eligibility to appear for 4<sup>th</sup> semester examination

A candidate shall be promoted to 6<sup>th</sup> semester provided he/she has successfully completed Industrial Training (Passed) and he / she puts the required percentage of attendance in the 5<sup>th</sup> semester and pay the industrial assessment fee. A candidate, who could not pay the 5<sup>th</sup> semester industrial assessment 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<sup>th</sup> semester.

A candidate is eligible to appear for 6<sup>th</sup> semester examination if he/she  
Puts the required percentage of attendance in 6<sup>th</sup> semester and  
Should not have failed in more than six backlogs subjects of 1<sup>st</sup> year, 3<sup>rd</sup> & 4<sup>th</sup> semesters put together.

Should not have failed in more than Six backlog subjects of 3<sup>rd</sup> and 4<sup>th</sup> semesters put together for IVC students.

### **For Diploma Courses of 3 ½ Years duration:**

i) MET/ CH/ CHPP/ CHPC/ CHOT/ TT

1) 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 upto 10%) i.e. attendance after condonation on Medical grounds should not be less than 65% and pay the examination fee.

2) 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.

3) 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.

4) A candidate is eligible to appear for the 4<sup>th</sup> semester exam if he/she

- i) Puts the required percentage of attendance in the 4<sup>th</sup> semester
  - ii) Should not have failed in more than Four backlog subjects of 1<sup>st</sup> year.
- 5) 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.
- 6) Promotion from 5<sup>th</sup> to 6<sup>th</sup> semester is automatic (i.e., from 1<sup>st</sup> spell of Industrial Training to 2<sup>nd</sup> spell) provided he/she puts the required percentage of attendance, which in this case would be 90 % attendance and attends for the VIVA-VOCE examination at the end of training.
- 7) A candidate shall be promoted to 7<sup>th</sup> semester of the course provided he/she has successfully completed both the spells of Industrial Training (Passed).
- 8) A candidate is eligible to appear for 7<sup>th</sup> semester examination if he/she
  - i) Puts the required percentage of attendance in the 7<sup>th</sup> semester and
  - ii) Should not have failed in more than 6 backlog subjects of 1<sup>st</sup> year, 3<sup>rd</sup> and 4<sup>th</sup> semesters put together.
  - iii) Should not have failed in more than Six backlog subjects of 3<sup>rd</sup> and 4<sup>th</sup> semester put together for IVC students.

ii) **DIPLOMA IN FOOTWEAR TECHNOLOGY:**

In respect of Diploma in Footwear Technology, the Industrial training is offered in two spells, the 1<sup>st</sup> spell of Industrial training after the First Year (i.e III Semester of the course) and the second spell of Industrial training after the V Semester (i.e VI Semester of the course). The promotion rules for this course are on par with the other sandwich Diploma courses except that there is no restriction on number of backlog subjects to get eligibility to appear for the 4<sup>th</sup> semester examination and

A candidate is eligible to appear for 5<sup>th</sup> semester examination if he / she  
 Puts the required percentage of attendance in the 5<sup>th</sup> semester and  
 Should not have failed in more than four subjects of 1<sup>st</sup> year.

## **OTHER DETAILS**

In case a candidate does not successfully complete the Industrial training, he / she will have to repeat the training at his / her own cost.

The I spell of Industrial training shall commence 10 days after the completion of the last theory examination of 4<sup>th</sup> Semester.

The Second spell of Industrial training shall commence within 10 days after the completion of I spell of Industrial training.

Each Semester of Institutional study shall be a minimum of 90 working days. (With 6 working days in a week i.e. from Monday to Saturday, with 7 periods of 50 minutes, duration per day.

### **12. STUDENTS PERFORMANCE EVALUATION**

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

- 1) First Class with Distinction shall be awarded to the candidates who secure an overall aggregate of 75% marks and above.
- 2) First Class shall be awarded to candidates who secure overall aggregate of 60% marks and above and below 75% marks.
- 3) 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) With respect to the intermediate vocational 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 levels of study shall alone be taken into consideration for determining the over all percentage of marks secured by the candidates for award of class/division.

- 4) Second Class shall be awarded to all students, who fail to complete the Diploma in the regular three years and four subsequent examinations, from the first admission.

### **13. EXAMINATION FEE SCHEDULE:**

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

## **14. STRUCTURE OF END EXAMINATION QUESTION PAPER**

### **Theory Examinations**

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 subject be considered. Examination paper is of 3/6/9 hour's duration.

Each theory paper consists of Section 'A' and Section 'B'. Section 'A' contains 10 short answer questions. All questions are to be answered and each carries 3 marks  
Max. Marks: 10 x 3 = 30.

Section B contains 8 essay type questions including Numerical questions, out of which 5 questions each carrying 10 marks are to be answered. Max.Marks: 5 x 10 = 50.Total Maximum Marks: 80

For Engineering Drawing Subject (107) consist of section 'A' and section 'B'. Section 'A' contains four (4) questions. All questions in section 'A' are to be answered and each carries 5 marks. Max. Marks: 4 x 5=20. Section 'B' contains six (6) questions. Out of which four (4) questions to be answered and each question carries 10 Marks. Max. Marks 4 x 10 = 40.

### **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: 60%

In case of practical examinations with 50 marks, the marks will be worked out basing on the above ratio.

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

#### **15. ISSUE OF MEMORANDUM 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.

#### **16. MAXIMUM PERIOD FOR COMPLETION OF DIPLOMA COURSES**

Maximum period for completion of the course 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.

#### **17. ELIGIBILITY FOR AWARD OF DIPLOMA**

A candidate is eligible for award of Diploma Certificate if he / she fulfils 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 has completed all the subjects.

Students who fail to fulfill 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.

#### **18. RECOUNTING, ISSUE OF XEROX COPY OF VALUED ANSWER SCRIPT & REVERIFICATION:**

- (a) A candidate desirous of applying for Recounting/ issue of Xerox copy of valued answer scripts/ Reverification should submit the application to the Secretary, State Board of Technical Education and Training, A.P., Hyderabad – 500 063 within 15 days from the date of receipt of Tabulated Marks Statement by the Principal of concerned Polytechnic or the date specified.

Recounting shall be done for any TWO theory subjects per Year/Semester only, including drawing subjects. No request for recounting shall be entertained from any candidate who is reported to have resorted to Malpractice in that examination. The fee prescribed for Recounting should be paid by way of Demand Draft drawn on any Scheduled Bank payable at Hyderabad in favour of the Secretary, State Board of Technical Education and Training, A.P., Hyderabad. The verification of the totaling will be done by an Officer of the Board and will be intimated to the candidate by post only.

The following documents should be invariably be enclosed with the application failing which the application will not be considered.

- (i) Marks secured as per Tabulated Marks Sheet certified by the Principal.
- (ii) Demand draft towards the payment of fee
- (iii) Self – addressed and stamped envelopes of 11” X 5” size.

The applications received after the prescribed date will not be accepted and any correspondence in this regard will not be entertained.

**b) FOR ISSUE OF XEROX COPIES OF VALUED ANSWER SCRIPTS**

1. A candidate desirous of applying for Xerox copy of valued answer script/ scripts should submit the application to the Secretary, State Board of Technical Education and Training, A.P., Hyderabad – 500 063 along with the required fee in the form of Demand Draft within 07 days from the date of receipt of Tabulated Marks Statement by the Principal of concerned Polytechnic or the date specified in the covering letter which ever is earlier.
2. Xerox copies of valued answer scripts will be issued to all theory subjects including drawing subjects.
3. The following documents should invariably be enclosed with the application
  - (1) Marks secured as per Tabulated Marks Sheets certified by the Principal
  - (2) Self-addressed Stamped Envelope/Cloth-line cover of size 10” x 14”.
  - (3) Fee in the form of Demand Draft

**c) FOR RE-VERIFICATION OF THE VALUED ANSWER SCRIPT**

A candidate desirous of applying for Re-verification of valued answer script should submit the application to the Secretary, State Board of Technical Education and Training, A.P., Hyderabad – 500 063 along with the required fee in the form of Demand Draft, within 15 days from declaration of result.

Re-verification of valued answer script shall be done for all theory subjects including drawing subjects.

The following documents should invariably be enclosed with the application failing which the application will not be considered.

- Marks secured as per Tabulated Marks Sheets certified by the Principal.
- Fee in the form of Demand Draft.

**19. MAL PRACTICE CASES:**

If any candidate resorts to any Mal Practice during examinations, he / she shall be booked and the Punishment shall be awarded as per rules and regulations framed by SBTET from time to time.

20. **DISCREPANCIES/ PLEAS:**

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

21. **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.

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 from time to time.

22. **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 candidate so as to facilitate this work and avoid errors in tabulation of results.

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. **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 are within the jurisdiction of Hyderabad.
- iii. In case of any ambiguity in the interpretation of the above rules, the decision of the Secretary, SBTET is final.

**DIPLOMA IN MECHANICAL ENGINEERING  
SCHEME OF INSTRUCTIONS AND EXAMINATION  
CURRICULUM-2009  
(FIRST YEAR)**

Sub Code	Name of the Subject	Instruction Periods/ Week		Total Periods Per Year	Scheme Of Examinations			
		Theory	Practicals		Duration (hrs)	Sessional Marks	End Exam Marks	Total Marks
<b>THEORY SUBJECTS</b>								
M-101	English -I	2	-	60	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 and Environmental Studies	4	-	120	3	20	80	100
M-105	Workshop Technology	5	-	150	3	20	80	100
<b>PRACTICAL SUBJECTS</b>								
M-106	Workshop Practice - I	-	6	180	3	40	60	100
M-107	Engineering Drawing	-	6	180	3	40	60	100
M108	Physics Laboratory	-	3	90	3	20	30	50
M-109	Chemistry Laboratory	-			3	20	30	50
M-110	Information Technology laboratory	-	4	120	3	40	60	100
-	Group Task / Seminar	-	3	90	-	-	-	-
	<b>Total</b>	<b>20</b>	<b>22</b>	<b>1260</b>	<b>-</b>	<b>260</b>	<b>640</b>	<b>900</b>



**DIPLOMA IN MECHANICAL ENGINEERING**  
**SCHEME OF INSTRUCTIONS AND EXAMINATION**  
**CURRICULUM-2009**  
**(III Semester)**

Sub Code	Name of the Subject	Instruction Periods/Week		Total Periods Per Semester	Scheme Of Examinations			
		Theory	Practicals		Duration (hrs)	Sessional Marks	End Exam Marks	Total Marks
<b>THEORY SUBJECTS</b>								
M-301	English -II	3	-	45	3	20	80	100
M-302	Engineering Mathematics –II	4	-	60	3	20	80	100
M-303	Engineering Mechanics	5	-	75	3	20	80	100
M-304	Electrical Engg & Basic Electronics	5	-	75	3	20	80	100
M-305	Thermal Engineering-I	5	-	75	3	20	80	100
M-306	Manufacturing Technology –I	5	-	75	3	20	80	100
<b>PRACTICAL SUBJECTS</b>								
M-307	Machine Drawing	-	6	90	3	40	60	100
M-308	Mechanical Engg. Laboratory	-	3	45	3	20	30	50
M-309	Electrical Engg Laboratory	-			3	20	30	50
M-310	CAD Lab- I	-	6	45	3	40	60	100
M-311	Workshop Practice – II	-			3	40	60	100
	<b>Total</b>	<b>27</b>	<b>15</b>	<b>630</b>	<b>-</b>	<b>280</b>	<b>720</b>	<b>1000</b>

**DIPLOMA IN MECHANICAL ENGINEERING  
SCHEME OF INSTRUCTIONS AND EXAMINATION  
CURRICULUM-2009  
(IV Semester)**

Sub Code	Name of the Subject	Instruction		Total Periods Per Semester	Scheme Of Examinations			
		Periods/Week			Duration (hrs)	Sessional Marks	EndExam Marks	Total Marks
		Theory	Practical					
<b>THEORY SUBJECTS</b>								
M-401	English-III	3	-	45	3	20	80	100
M-402	Manufacturing Technology-II	5	-	75	3	20	80	100
M-403	Strength of Materials	5	-	75	3	20	80	100
M-404	Engineering Materials	5	-	75	3	20	80	100
M-405	Thermal Engineering-II	5	-	75	3	20	80	100
M-406	Hydraulics & Fluid Power systems	5	-	75	3	20	80	100
<b>PRACTICAL SUBJECTS</b>								
M-407	Production Drawing	-	3	45	3	40	60	100
M-408	Workshop Practice-III	-	6	90	3	40	60	100
M-409	Material Testing Laboratory	-	3	45	4	20	30	50
M-410	Hydraulics &Hydraulic Machines Laboratory	-			3	20	30	50
	Group Task / Seminar	-	2	30*	-	-	-	-
	<b>Total</b>	<b>28</b>	<b>14</b>	<b>630</b>	<b>-</b>	<b>240</b>	<b>660</b>	<b>900</b>

\* Out of this 30 periods 15 periods were allocated for Production Drawing Theory.

**DIPLOMA IN MECHANICAL ENGINEERING  
SCHEME OF INSTRUCTIONS AND EXAMINATION  
CURRICULUM-2009**

**M-501 INDUSTRIAL TRAINING**

(Practical Training)

**V SEMESTER**

S.NO	Subject	Duration	Items	Max Marks	Remarks
1	Practical Training in the Industry	6 Months	1.First Assessment (at the end of 3 <sup>rd</sup> month)	100	
			2. Second Assessment (at the end of 6th month)	100	
			3.Training Report		
			a) Log Book	30	
			b) Training report	30	
			4. Seminar	40	
<b>TOTAL PER SEMESTER</b>				<b>300</b>	

- The industrial training shall carry 300 marks and pass marks is **50%**.
- A candidate failing to secure the minimum marks should complete it at his own expenses.
- During Industrial training the candidate shall put in a minimum of 90%attendance.

**DIPLOMA IN MECHANICAL ENGINEERING  
SCHEME OF INSTRUCTIONS AND EXAMINATION  
CURRICULUM-2009  
(VI Semester)**

Sub Code	Name of the Subject	Instruction Periods/Week		Total Periods Per Semester	Scheme Of Examinations			
		Theory	Practical		Duration (hrs)	Sessional Marks	End Exam Marks	Total Marks
<b>THEORY SUBJECTS</b>								
M-601	English -IV	2	-	30	3	20	30	50
M-602	Industrial Management and Entrepreneurship	5	-	75	3	20	80	100
M-603	Industrial Engineering & Estimating and costing	5	-	75	3	20	80	100
M-604	CAD/CAM	5	-	75	3	20	80	100
M-605	Design of Machine Elements	5	-	75	3	20	80	100
M-606	<b>ELECTIVES</b>	5	-	75	3	20	80	100
	(A) Refrigeration & Air Conditioning							
	(B) Automobile Engineering							
	(C) Energy sources & Power plant Engineering							
<b>PRACTICAL SUBJECTS</b>								
M-607	CAD Lab - II	-	6	45	3	20	30	50
M-608	CAM Lab	-		45	3	20	30	50
M-609	Thermal Engineering Lab	-	3	45	3	20	30	50
M-610	R&A/C Laboratory	-			3	20	30	50
M-611	Workshop Practice-IV	-	3	45	3	20	30	50
M-612	Servicing and Maintenance lab	-			3	20	30	50
M-613	Project Work	-	3	45	3	40	60	100
	<b>Total</b>	<b>27</b>	<b>15</b>	<b>630</b>	<b>-</b>	<b>280</b>	<b>670</b>	<b>950</b>

**I YEAR**

## ENGLISH-I

**Subject Title** : English-I

**Subject code** : M-101

**Periods / Week** : 2

**Periods / Year** : 60

### TIME SCHEDULE


**ENGINEERING MATHEMATICS – I**  
(Common Subject)

Subject title : Engineering Mathematics -I  
 Subject code : M- 102  
 Periods per week : 05  
 Total periods per Year : 150

**TIME SCHEDULE**

Sno	Major Topics	No. of Periods	Weightage of marks	Short type	Essay type
1	<b>Unit-I</b> -Bridging of fundamentals In mathematics	12	6	2	-
2	<b>Unit-II-Algebra:</b> Matrices	15	10	-	1
3	Partial Fractions	5	3	1	-
4	<b>Unit-III-Trigonometry:</b> Compound Angles	5	3	1	-
5	Multiple and Sub-multiple angles	5	3	1	-
6	Transformations	6	5	-	1/2
7	Inverse Trigonometric Functions	5	5	-	1/2
8	Trigonometric Equations	5	5	-	1/2
9	Properties of Triangles	8	5	-	1/2
10	Complex Numbers	6	3	1	-
11	<b>Unit-IV-Co-ordinateGeometry:</b> Straight Lines	2	3	1	-
12	Circles	5	3	1	-
13	Elements of Conics	1	0	-	-
14	Parabola	5	5	-	1/2
15	Ellipse	5	5	-	1/2
16	Hyperbola	5	5	-	1/2
17	Three Dimensional Geometry	8	5	-	1/2
18	<b>Unit-V-DifferentialCalculus:</b> Limits	5	3	1	-
19	Methods of Differentiation	20	13	1	1
20	<b>Unit-VI- Applications of the Derivative</b> Geometrical Applications	6	5	-	1/2
21	PhysicalApplications	6	5	-	1/2
22	MaximaandMinima	6	5	-	1/2
23	ErrorsandApproximations	4	5	-	1/2
	<b>TOTAL</b>	<b>150</b>	<b>110</b>	<b>10</b>	<b>8</b>

## Objectives:

### Unit-1. Bridging of fundamentals in Mathematics:

- 1.1 Explain the bracket operations such as  $a + \{b + (c - d)\}$ ,  $\frac{-1}{2}m - \{-\frac{1}{2}m - \overline{m - n}\}$  etc.
- 1.2 Explain the ratios and properties such as componendo, dividendo, Componendo and dividendo rules such as
- $$\frac{a}{b} = \frac{c}{d} \Rightarrow \frac{a+b}{b} = \frac{c+d}{d} \text{ (componendo)} \quad \frac{a}{b} = \frac{c}{d} \Rightarrow \frac{a-b}{b} = \frac{c-d}{d} \text{ (dividendo)}$$
- $$\frac{a}{b} = \frac{c}{d} \Rightarrow \frac{a+b}{a-b} = \frac{c+d}{c-d} \text{ (componendo and dividendo)}$$

Also explain the variation concept (direct and inverse) such as

$x$  varies as  $y \Leftrightarrow \frac{x}{y} = \text{constant}$ .,  $x$  varies inversely as  $y \Leftrightarrow xy = \text{constant}$ . Solve simple problems.

- 1.3. Explain Literal Values and Literal Coefficients. Solve simple problems such as  $p = 2a - 3b$ ,  $q = 3b - 4c$ ,  $r = 5a - 2b$  find  $3p + 2q - 5r$ .

*multiply  $p$  with  $q$  and divide  $p$  by  $q$  when  $p = 2x^2 + 3x + 4$  and  $q = 3x - 1$*

- . Explain the procedure of Handling Vulgar fractions such as

$$\frac{\frac{x}{2x-1} + \frac{2x+4}{x-2}}{1 - \frac{x+3}{2x-4}}, \quad \frac{4}{1 - \frac{1}{x}} + \frac{2}{2 - \frac{3}{y}} \text{ etc.}$$

Explain the formulae for basic algebraic identities in the form of forward and backward applications like

$$(a+b)^2 = a^2 + b^2 + 2ab \text{ and also } a^2 + b^2 - ab = (a+b)^2 - 3ab \text{ or } (a-b)^2 + ab.$$

And also express  $x^2 + 3x + 5$  in the form of  $\left(x + \frac{3}{2}\right)^2 + \left(\frac{\sqrt{11}}{2}\right)^2$  etc.

- 1.6 Explain the functional notation  $y = f(x)$ ,  $z = f(x, y)$  and  $u = f(x, y, z)$  with simple illustrative examples and their evaluation. Also explain the definition of a function classically as  $f : \mathbf{A} \rightarrow \mathbf{B}$ , Domain, Range, interval as subset of set of real numbers.
- 1.7 Explain the polynomials of Second, Third and fourth degree definitions, rational functions with arithmetic operations on them, Homogeneous functions, symmetric expressions and  $\Sigma$  notations with suitable examples in each case.
- 1.8 Explain surds and rationalizing factors with suitable simple examples.
- 1.9 Explain logarithms with basic properties.
- 1.10 Explain solving a quadratic equation by factorization and formula methods and solving fourth and third degree equations using remainder theorem with simple constructed examples.
- 1.11 State the definitions of  ${}^n P_r$ ,  ${}^n C_r$ .
- 1.12 State Binomial expansions of the type  $(x \pm a)^n$ ,  $(1 \pm x)^{-1}$ ,  $(1 \pm x)^{-2}$ ,  $(1 \pm x)^{-3}$ .
- 1.13 Explain the exponential constant  $e$ , exponential function, exponential series, Logarithmic Series, and also define Hyperbolic and inverse Hyperbolic functions with useful identities.
- 1.14 Define the basic Trigonometric ratios, their properties and allied angles formulae.



- 1.15 Explain two dimensional co-ordinate system, distance and ratio formulae centroid and the meaning of the graph of a function with suitable examples.

## Unit-II. Algebra

### Matrices

- 2.1 Definition of a matrix, various types of matrices with examples, define the order of a matrix- define square matrix and 3rd order square matrix with examples.
- 2.2 Define sum, scalar multiplication and product of matrices, algebra of matrices (associative, distributive, commutative properties) with examples and counter examples.
- 2.3 Define the transpose of a matrix, symmetry and non -symmetry of matrices, resolving a square matrix in to a sum of a symmetric and non- symmetric matrices-Examples in all cases.
- 2.4 Define minor, cofactor of an element of a 3x3 square matrix as determinant of 2x2 square matrix with examples. Define and determine the adjoint of a square matrix give examples.
- 2.5 Define determinant of a 3x3 matrix- Laplacian expansion with examples. Define singular and non singular matrices.
- 2.6 Define the multiplicative inverse of a 3x3 matrix, relation between the Adjoint and inverse leading to the formula  $A^{-1} = adj A / det A$ .(proof not necessary) with examples.
- 2.7 System of 3 linear equations in 3 unknowns, matrix representation, solution by matrix inversion method and Cramer's rule-examples
- 2.8 Elementary row and column operations on a 3x3 matrix-examples, Gauss-Jordan method to solve a system of 3 linear equations in 3 unknowns with examples.
- 2.9 Row operations for evaluating the determinant of a 3x3 matrix with simple illustrative examples. Also state properties of determinants with illustrative examples.

### 3. Partial Fractions

- 3.1 Define rational, proper and improper fractions of functions.
- 3.2 Explain the Procedure of resolving rational fractions of the type mentioned below into partial fractions.

$$i) \frac{f(x)}{(x+a)(x+b)(x+c)}$$

$$ii) \frac{f(x)}{(x+a)^2(x+b)(x+c)}$$

$$iii) \frac{f(x)}{(x^2+a)(x+b)}$$

$$iv) \frac{f(x)}{(x+a)(x^2+b)^2}$$

### Unit-III Trigonometry

#### 4.0 Compound Angles

- 4.1 Define compound angles, State the formulas of  $\sin(A\pm B)$ ,  $\cos(A\pm B)$ ,  $\tan(A\pm B)$  and  $\cot(A\pm B)$ , simple examples, derive the values of  $\sin 15^\circ$ ,  $\cos 15^\circ$ ,  $\sin 75^\circ$ ,  $\cos 75^\circ$ ,  $\tan 15^\circ$ ,  $\tan 75^\circ$  etc.
- 4.2 Derive identities like  $\sin(A+B) \sin(A-B) = \sin^2 A - \sin^2 B$  etc. Solve simple problems on compound angles.

## 5.0 Multiple and Sub multiple Angles

- 5.1 Derive the formulae of multiple angles  $2A$ ,  $3A$  etc and sub multiple angle  $A/2$  in terms of angle  $A$  of trigonometric functions.
- 5.2 Derive useful allied formulas like  $\sin A = \sqrt{(1-\cos 2A)}/2$  etc
- 5.3 Provide examples on the above formulae

## 6.0 Transformations

- 6.1 Derive the formulae on transforming sum or difference of two trigonometric ratios in to a product and vice versa- examples on these formulae.
- 6.2 Apply these formulae to sum or difference or product of three or more terms and solve problems.

## 7.0 Inverse Trigonometric Functions

- 7.1 Understand the concept of the inverse of a trigonometric function by selecting an appropriate domain and range. Define inverses of six trigonometric functions along with their domains and ranges.
- 7.2 To derive relations between inverse trigonometric functions so that given  $A = \sin^{-1} x$ , to Express angle  $A$  in terms of other inverse trigonometric functions- with examples.
- 7.3 State various properties of inverse trigonometric functions and identities like  $\sin^{-1} x + \cos^{-1} x = \pi/2$  etc. Derive formulae like  $\tan^{-1} x + \tan^{-1} y = \tan^{-1} ((x+y)/(1-xy))$  etc., and solve simple problems.

## 8.0 Trigonometric Equations

- 8.1 Explain what is meant by the solution of trigonometric equations. To find the general solutions of  $\sin x = k$ ,  $\cos x = k$  and  $\tan x = k$  with appropriate examples.
- 8.2 To 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.

## 9.0 Properties and Solutions of Triangles

- 9.1 To state sine rule, cosine rule, tangent rule and projection rule.
- 9.2 Give the formulas for  $\sin A/2$ ,  $\cos A/2$ ,  $\tan A/2$  and  $\cot A/2$  in terms of semi-perimeter and sides  $a, b, c$  and solve problems.
- 9.3 Give various formulae for the area of a triangle. Solve problems on the above formulae.
- 9.4 Explain what is meant by solving a triangle; solve a triangle given (i) three sides, (ii) two sides and an included angles, (iii) two sides and an opposite angle- case of two solutions and (iv) one side and two angles.

## 10.0 Complex numbers:

- 10.1 Give the definition of a complex number, its modulus and Conjugate of a complex number and their properties.
- 10.2 Define the arithmetic operations on Complex numbers with examples.
- 10.3 Define amplitude of a complex number and give the modulus-amplitude (polar) form ,Exponential (Euler )form of a complex number - illustrative examples on all the above.
- 10.4 State DeMoivre's Theorem (proof not necessary) and its applications to complex numbers eg. Finding the roots, powers, simplifications of a complex number with illustrative examples.

## **Unit-IV Coordinate Geometry**

### **11.0 Locus, Translation of axes and Straight lines**

- 11.1 Explain the concepts of locus of a point, shifting of origin(translation of axes) with illustrative examples.
- 11.2 Provide equations of a straight line in various forms, explain the slope, angle between two lines, point of intersection of lines, perpendicular distance from a point to a line, distance between two parallel lines, provide examples.

### **12.0 Circles**

- 12.1 Define a circle, provide circle equation given (i) center and radius, (ii) given two ends of a diameter with examples.
- 12.2 State the general equation of a circle and explain the procedure to find the centre, radius from it with examples.
- 12.3 Problems on finding the equation of circle passing through three given points.
- 12.4 Define the tangent and normal at a point on the circle and problems relating to finding their equations (Derivation of general Equations not necessary.). Define the pole and polar of a circle and find the pole of a line and polar of a point w.r.t. a circle.(Derivation of general Equations not necessary)-Simple examples only.

### **13.0 Elements of Conics**

- 13.1. Define a conic, explain the terms focus, directrix, eccentricity, axes and latus rectum of a conic.
- 13.2 Find the Equation of a Conic, given its focus, eccentricity and directrix.

### **14.0 Parabola**

- 14.1 Derive the standard equation of a parabola with vertex at origin and one of the coordinate axes as its axis (four forms) and also the standard forms with translation of axes (shifting of origin, vertex at  $(h,k)$  and axis parallel to one of the coordinate axes).
- 14.2 Given the equation of parabola, explain how to reduce it to standard form and find its vertex, focus, directrix, axis, latus rectum etc.-illustrative examples.
- 14.3 To find the equation of a parabola given any two of focus, vertex and directrix-examples
- 14.4 To find the equation of a parabola passing through 3 given points.
- 14.5 Applications of parabola to practical problems.

### **15.0 Ellipse**

- 15.1 Derive the standard equation of an ellipse , Types of ellipse with (i) center at origin, coordinate axes as axes and (ii) center at  $(h,k)$  and axes parallel to coordinate axes.
- 15.2. Find the foci, centre, vertices, axes, directrices, latera recta for an ellipse in standard form and Their length and prove that sum of focal distances from any point on the ellipse is equal to length of major axis-solve problems.
- 15.3 To find the equation of an ellipse (i) given focus, eccentricity and equation of directrix and (ii) in standard form and passing through two given points.
- 15.4 Applications of ellipse to practical problems-simple cases.

### 16.0 Hyperbola

- 16.1 Derive the standard equation of hyperbola, explain different forms, define rectangular and conjugate hyperbola.
- 16.2 Mention the properties of hyperbola with examples.
- 16.3 To find the equation of a hyperbola given its (i) focus, directrix and eccentricity, (ii) asymptotes.
- 16.4 To find the centre, foci, vertices, axes, directrices, latera recta and the length of latus rectum given equation of a hyperbola in standard form.

### 17.0 Three Dimensional Geometry

- 17.1 Explain the three dimensional coordinate system.
- 17.2 Explain the distance between two points with problems.
- 17.3 Explain the ratio formula with examples.
- 17.4 State the formulae to find the centroid of a triangle and the tetrahedron with simple examples.
- 17.5 Define the direction cosines and direction ratios of a line, angle between two lines with Illustrative examples.
- 17.6 State the general equation of a plane, its intercept form, plane passing through a given point and perpendicular to a line whose direction ratios are given-angle between two planes -simple illustrative examples and problems

## Unit-V Differential Calculus

### 18.0 Limit and Continuity

- 18.1 Explain the concept of limit and meaning of  $\lim_{x \rightarrow a} f(x) = l$  and State the properties of limits .
- 18.2 Mention the Standard limits  $\lim_{x \rightarrow a} \frac{x^n - a^n}{x - a}$ ,  $\frac{\sin x}{x}$ ,  $\frac{\tan x}{x}$ ,  $\frac{a^x - 1}{x}$ ,  $\frac{e^x - 1}{x}$ ,  $(1+x)^{\frac{1}{x}}$  as  $x \rightarrow 0$  and also  $\lim_{x \rightarrow \infty} \left(1 + \frac{1}{x}\right)^x$  (All without proofs) with illustrative examples applying the above and also evaluate the limits of the type  $\lim_{x \rightarrow a} \frac{ax^2 + bx + c}{\alpha x^2 + \beta x + \gamma}$ ,  $\lim_{x \rightarrow \infty} \frac{f(x)}{g(x)}$ .
- 18.3 Explain the concept of continuity of a function at a point and in an interval. Some examples whether a given function is continuous or not can be mentioned.

### 19.0 Methods of differentiation

- 19.1 State the concept of derivative of a function  $y = f(x)$  –definition, first principle as  $\lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$  and also use the appropriate standard notations to denote the derivative of a function. Mention the significance of derivative in scientific and engineering applications.
- 19.2 Find the derivatives of elementary functions like  $x^n, a^x, e^x, \text{Log}x, \text{Cos}x, \text{Sin}x, \text{Tan}x, \text{Sec}x, \text{Cosec}x$  and  $\text{Cot}x$  using the first principles and also find the derivatives of simple functions from the first principle .
- 19.3 State the rules of differentiation of *Sum, Difference Scalar multiplication, Product and Quotient* of functions with illustrative and simple examples .
- 19.4 Explain the method of differentiation of a function of a function (Chain rule) with illustrative examples such as
- i)  $2t^2 + 3/\sqrt{t}$
  - ii)  $x^2 \sin^2 x$
  - iii)  $x/\sqrt{x^2+1}$
  - iv)  $\log [\sin (\cos x)]$ .
- 19.5 Find the derivatives of Inverse Trigonometric functions and examples using the Trigonometric transformations.
- 19.6 Explain the method of differentiation of a function with respect to another function and also Differentiation of Parametric functions with illustrative examples.
- 19.7 Explain the procedure of differentiating of hyperbolic and implicit functions with examples.
- 19.8. Explain the need of taking logarithms for differentiating some functions with illustrative examples like  $[f(x)]^{g(x)}$ .
- 19.9. Explain the concept of successive differentiation –derivatives of second and higher order-examples.
- 19.10 Explain the concept of functions of several variables, partial derivatives and difference between the ordinary and partial derivatives with simple illustrative examples.
- 19.11 Explain the definition of Homogenous function of degree n and Statement of Euler's Theorem for Homogeneous functions with applications to simple problems.

## Unit-VI Applications of the Derivative

### 20.0 Geometrical Applications of Derivatives

- 20.1 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.
- 20.2. To find the tangent and normal to the curve  $y=f(x)$  at any point on the curve using the slope found using the derivative.
- 20.3. Define the lengths of tangent, normal, sub-tangent and sub normal at any point on the curve  $y=f(x)$  – Provide formulae and examples.
- 20.4 Explain the concept of angle between two curves and procedure for finding the angle between two given curves with illustrative examples.

### 21.0 Physical Applications of Derivatives

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

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

## **22.0 Derivatives to find extreme values**

- 22.1 Define the concept of increasing and decreasing functions. Explain the conditions to find points where the given function is increasing or decreasing with illustrative examples.
- 22.2 Explain the procedure to find the extreme values (maxima or minima) of a function of single variable-simple problems yielding maxima and minima.
- 22.3 Solve problems on maxima and minima in applications like finding areas, volumes etc.

## **23.0. Derivatives to find Errors and Approximations**

- 23.1 Use the definition of derivative to find the approximate values of a function of single variable and to find the errors in dependent or independent variables as the case may be-appropriate applications.
- 23.2 Provide formulae for relative error and percentage error in evaluating the dependent variable given the corresponding errors in independent variable. Provide simple examples with functions of one variable.

## **COURSE CONTENT**

### **UNIT – I**

#### **1. Bridging of fundamentals in mathematics:**

Bracket operations-examples-Ratio and Proportion, Variation-examples-Literal values-examples- Literal coefficients-examples-Identities-examples with forward and backward applications-Polynomials-examples-Rational functions-examples-Homogenous expressions-examples-Symmetrical expressions-examples-Functional notation-Exponential, logarithmic, hyperbolic functions and their series—Elementary combinatorial concepts -examples -Binomial expansion-examples -Vulgar fractions – examples- Elementary theory of equations-examples-Surds- examples-Logarithms- examples-Trigonometric ratios-examples-Basic concepts of coordinate geometry- examples.

### **UNIT-II**

#### **2.Matrices:**

Matrices of 3<sup>rd</sup> order: Definition of a matrix-types of matrices-examples-algebra of matrices-Transpose of a matrix-Symmetric, skew symmetric matrices-Minor, cofactor of an element-Determinant of a square matrix-Laplace's expansion-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, Matrix inversion method-examples-Elementary row and column operations on matrices and determinants-Gauss-Jordan method to solve a system of equations. .

#### **3. Partial Fractions :** Procedure for resolving rational functions of the types mentioned below in to into partial fractions.

$$f(x)$$

$$\begin{aligned} \text{i)} & \frac{\quad}{(x+a)(x+b)(x+c)} \\ \text{ii)} & \frac{f(x)}{(x+a)^2(x+b)(x+c)} \\ \text{iii)} & \frac{f(x)}{(x^2+a)(x+b)} \\ \text{iv)} & \frac{f(x)}{(x+a)(x^2+b)^2} \end{aligned}$$

### UNIT –III

#### Trigonometry

- 4 Compound angles-Formulas of  $\sin(A\pm B)$ ,  $\cos(A\pm B)$ ,  $\tan(A\pm B)$ ,  $\cot(A\pm B)$ , and related identities with problems.
- 5 Multiple and sub multiple angles-trigonometric ratios of multiple angles  $2A, 3A$  and submultiple angle  $A/2$  - problems.
- 6 Transformations of products into sums or differences and vice versa-simple problems
- 7 Inverse trigonometric functions-definition, domains and ranges-basic properties-problems.
- 8 Trigonometric equations- concept of a solution, principal value and general solution of trigonometric equations :  $\sin x = k$ ,  $\cos x = k$ ,  $\tan x = k$ . – Solutions of simple quadratic equations, equations involving multiple angles and usage of transformations- problems.
- 9 Properties and solutions of triangles- relation between sides and angles of a triangle- sine rule, cosine rule, tangent rule and projection rule-area of a triangle-solving a triangle- problems.
- 10 Complex Numbers : Definition of a complex number, Modulus and conjugate of a complex number, Arithmetic operations on complex numbers, Modulus- Amplitude (polar) form , Exponential form(Euler) form of a complex number-Problems.DeMoivre's Theorem and its applications in complex numbers- Simple problems.

### UNIT-IV

#### Coordinate geometry

- 11 Concepts of locus, change of axes- various forms of straight lines – angle between lines, perpendicular distance from a point, distance between parallel lines-examples.
- 12 Circle-definition-Circle equation given center and radius- circle equation with given diameter-general equation-finding center, radius-tangent, normal, pole and polar of a circle.
- 13 Definition of a conic- focus, directrix and eccentricity-finding the equation of a conic given focus, directrix and eccentricity

- 14 Parabola- Standard forms- finding focus, vertex, directrix etc. of a parabola- simple applications-
- 15 Ellipse- Standard forms- finding foci, vertices, directrices etc. of an ellipse- properties of ellipse- simple application problems.
- 16 Hyperbola- Standard forms- finding foci, vertices, directrices etc. of a hyperbola- properties of hyperbola- simple problems
- 17 Three dimensional geometry: Coordinate system-distance between two points- ratio formula-direction cosines and ratios of a line- angle between two lines- centroid of a triangle and tetrahedron-simple equation of a plane-general form- angle between planes.

## **UNIT-V**

### **Differential Calculus**

- 18 Concept of Limit- Definition- Properties of Limits and Standard Limits - Simple Problems-Continuity of a function at a point- Simple Examples only.
- 19 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 equations, Derivative of hyperbolic, Implicit functions Functions, Logarithmic Differentiation –problems in each case.Successive differentiation- examples-.Partial differentiation, Euler's Theorem-simple problems.



## **UNIT-VI**

### **Applications of the Derivative:**

- 20 Geometrical meaning of the derivative, equations of Tangent and normal to a curve at any point. The lengths of Tangent, Normal, Subtangent and Subnormal to the curve at any point. Angle between the curves- problems.
- 21 Physical applications of the derivative –velocity, acceleration, derivative as a rate Measure –Problems.
- 22 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.
- 23 Applications of derivative in finding errors and approximations of functions and simple problems.

### **REFERENCE:**

- (1) **Text book of Engineering Mathematics –I** by G.Srinagesh, and others – FALCON publishers
- (2) **Text book of Engineering Mathematics –I** by Dr.J.Sairam and others – UNI-TECH SERIES.
- (3) **A Text book of intermediate Mathematics –I & II** by Telugu Academy.
- (4) **Differential Calculus by Manicavachagom Pillai**
- (5) **Elementary Algebra by Hall & Knight.**
- (6) **Text book of Engineering Mathematics –I** by Radiant publishers.
- (7) **Trigonometry** By S.L Loney

## ENGINEERING PHYSICS

Subject Title	:	Engineering Physics
Subject Code	:	M-103
Periods per week	:	04
Total periods per year	:	120

### TIME SCHEDULE

S.No	Major Topics	No. of Periods	Weightage of Marks	Short Answer Type	Essay Type
1.	Units and Dimensions	08	03	1	-
2.	Elements of Vectors	10	13	1	1
3.	Kinematics	13	13	1	1
4.	Friction	08	03	1	-
5.	Work, Power and Energy	10	10	-	1
6.	Simple Harmonic Motion	11	13	1	1
7.	Heat & Thermodynamics	13	13	1	1
8.	Sound	11	13	1	1
9.	Properties of matter	14	13	1	1
10	Electricity & magnetism	14	13	1	1
11.	Modern Physics	08	03	1	
	<b>Total:</b>	<b>120</b>	<b>110</b>	<b>10</b>	<b>8</b>

### OBJECTIVES

#### 1.0 UNITS AND DIMENSIONS

- 1.1 Introduction to units
- 1.2 Define Physical quantity, fundamental physical quantities and derived physical quantities
- 1.3 Define unit
- 1.4 Define fundamental units and derived units
- 1.5 State SI units with symbols
- 1.6 State Multiples and submultiples in SI system
- 1.7 Rules of writing S.I. units
- 1.8 State advantages of SI units
- 1.9 Define Dimensions and Dimensional formulae
- 1.10 Derive dimensional formulae of physical quantities
- 1.11 List dimensional constants and dimensionless quantities
- 1.12 State the principle of Homogeneity of Dimensions
- 1.13 Explain the applications of Dimensional Analysis with examples
- 1.14 State the limitations of dimensional analysis
- 1.15 Solve problems

#### 2.0 ELEMENTS OF VECTORS

- 2.1 Introduction to Vectors
- 2.2 Define Scalar and Vector quantities
- 2.3 Give examples for scalar and vector quantities
- 2.4 Represent vectors graphically
- 2.5 Types of Vectors (Proper Vector, Null Vector, Unit Vector, Equal Vectors, Negative Vector, Like Vectors, Co-Initial Vectors, Co-planar Vectors and Position Vector).
- 2.6 Explain addition and subtraction of vectors
- 2.7 Represent a vector in space using unit vectors (  $i, j, k$  )
- 2.8 Resolution of vectors
- 2.9 Resultant of the vectors by component method
- 2.10 State parallelogram law of vectors and illustrations
- 2.11 Derive formula for resultant ( Magnitude and direction )
- 2.12 State and Explain triangle law of vectors
- 2.13 State and Explain polygon law of vectors
- 2.14 Define Dot product of two vectors with examples ( Work done, Gravitational P.E )
- 2.15 Mention the properties of Dot product
- 2.16 Define Cross products of two vectors with example (Torque ,Linear velocity)
- 2.17 Mention the properties of Cross product.
- 2.18 Solve problems

### **3.0 KINEMATICS**

- 3.1 Recapitulation of equations of motion in a straight line
- 3.2 Define acceleration due to gravity
- 3.3 Derive expressions for Maximum Height, time of ascent, time of descent, time of flight and velocity on reaching the point of projection
- 3.4 Derivation for height of a tower when a body projected vertically upwards from the top
- 3.5 Define projectile motion with examples
- 3.6 Explain Horizontal projection
- 3.7 Derivation for the path of a horizontal projectile
- 3.8 Explain oblique projection
- 3.9 Derivation for the path of a oblique projectile
- 3.10 Derive formulae for maximum height, time of flight and Horizontal Range of a projectile, maximum range in oblique projection
- 3.11 Derive formula for magnitude and direction of resultant velocity in oblique projection
- 3.12 Solve problems

#### **4.0 FRICTION**

- 4.1 Introduction to friction
- 4.2 Examples of friction in daily life
- 4.3 Definition of friction
- 4.4 Types of friction
- 4.5 Concept of Normal reaction
- 4.6 State laws of static friction
- 4.7 State laws of kinetic friction
- 4.8 Define coefficients of friction
- 4.9 Angle of friction w.r.t. rough horizontal surface
- 4.10 Derivations for displacement and time taken to come to rest over a rough horizontal surface and work done by frictional force
- 4.11 Define Angle of repose
- 4.12 Explain Motion of a body on a rough inclined planes
- 4.13 Derive expressions for acceleration of a body on a rough inclined plane (UP & DOWN)
- 4.14 Derive expressions for acceleration of a body on a smooth inclined plane (UP & DOWN)
- 4.15 List the Advantages and Disadvantages of friction
- 4.16 Mention the methods of minimizing friction
- 4.17 Solve problems

#### **5.0. WORK, POWER AND ENERGY**

- 5.1 Define work
- 5.2 State SI units, dimensional formula for work
- 5.3 Explain the concept of power
- 5.4 Define power
- 5.5 State SI units, dimensional formula for power
- 5.6 Define energy
- 5.7 State SI units, dimensional formula for energy
- 5.8 Define potential energy
- 5.9 Derive the expression for Potential energy, with examples
- 5.10 Define kinetic energy
- 5.11 Derive the expression for kinetic energy, with examples
- 5.12 Work Energy theorem
- 5.13 Relation between Kinetic energy and momentum
- 5.14 State the law of conservation of energy and verify in the case of freely falling body
- 5.15 Law of conservation of energy in the case of simple pendulum-theory only
- 5.16 Define conventional and non conventional energy sources with examples
- 5.17 Solve problems

#### **6.0 SIMPLE HARMONIC MOTION**

- 6.1 Define S. H. M
- 6.2 State the conditions of S. H. M
- 6.3 Give examples of S. H. M
- 6.4 Derive the equation for S H M as projection of particle executing uniform circular motion
- 6.5 Derive expression for displacement
- 6.6 Derive expression for velocity
- 6.7 Derive expression for acceleration
- 6.8 Derive expression for period and frequency of S H M

- 6.9 Define phase of S H M
- 6.10 Derive expression for period of simple pendulum
- 6.11 Experiment for determination of acceleration due to gravity using simple pendulum.
- 6.12 Seconds pendulum
- 6.13 Solve problems

## **7.0 HEAT AND THERMODYNAMICS**

- 7.1 Introduction to expansion of gases
- 7.2 Explain Boyle's law
- 7.3 Experimental verification of Boyle's law
- 7.4 Explain absolute scale of temperature
- 7.5 State Charles laws
- 7.6 Derive ideal gas equation
- 7.7 Define gas constant and Universal gas constant
- 7.8 Explain why universal gas constant is same for all gases
- 7.9 State SI unit and value of universal gas constant
- 7.10 State the gas equation in terms of density
- 7.11 Differences between  $r$  and  $R$
- 7.12 Concept of internal energy
- 7.13 Definition of external work
- 7.14 Calculate external work done by a gas
- 7.15 Explain Isothermal process and Adiabatic process
- 7.16 State laws of thermodynamics
- 7.17 Define specific heats & molar specific heats of a gas
- 7.18 Derive relation  $C_p - C_v = R$
- 7.19 Solve problems

## **8.0 SOUND**

- 8.1 Introduction to sound
- 8.2 Distinguish between musical sound and noise
- 8.3 Explain noise pollution and state SI unit for noise
- 8.4 Explain causes of noise pollution
- 8.5 Explain effects of noise pollution
- 8.6 Explain methods of minimizing noise pollution
- 8.7 Explain the phenomenon of beats
- 8.8 Explain the applications of beats
- 8.9 Explain Doppler effect
- 8.10 Derive formula for apparent frequency – (i) Source in Motion and observer at rest  
(ii) Observer in motion and source at rest
- 8.11 Applications of Doppler effect
- 8.12 Explain reverberation and reverberation time
- 8.13 Write Sabine's formula
- 8.14 Explain echoes
- 8.15 Solve problems

## **9.0 PROPERTIES OF MATTER**

- 9.1 Introduction to Elasticity
- 9.2 Definitions of Stress and strain, their units and dimensional formulae
- 9.3 Statement of Hooke's law
- 9.4 Types of Stress
- 9.5 Types of strain
- 9.6 Types of moduli of elasticity

- 9.7 Definition of Surface Tension and examples
- 9.8 Explanation to Surface Tension with reference to molecular theory
- 9.9 Definitions of angle of contact and capillarity
- 9.10 State formula for Surface Tension based on capillarity
- 9.11 Experimental determination of surface tension by capillarity method
- 9.12 Concept of Viscosity, definition and examples
- 9.13 Newton's formula for Viscous force and definition of coefficient of Viscosity.
- 9.14 Effect of temperature on viscosity of liquids and gases
- 9.15 State Poiseuille's equation for coefficient of viscosity
- 9.16 Experimental determination of coefficient of viscosity
- 9.17 Solve problems

## **10.0 ELECTRICITY AND MAGNETISM**

- 10.1 Introduction to Electricity
- 10.2 Ohm's law and explanation
- 10.3 Definitions of specific resistance, conductance and their units
- 10.4 Statements of Kichoff's laws and explanation
- 10.5 Wheatstone's bridge
- 10.6 Meter bridge
- 10.7 Experimental determination of specific resistance using Meter Bridge
- 10.8 Introduction to magnetism
- 10.9 Coulomb's inverse square law of magnetism
- 10.10 Defition of magnetic field and magnetic lines of force
- 10.11 Magnetic induction field strength-units and dimensions
- 10.12 Moment of couple on a bar magnet placed in a uniform magnetic field
- 10.13 Derivation for Magnetic induction field strength at a point on the axial line
- 10.14 Derivation for Magnetic induction field strength at a point on the equatorial line
- 10.15 Solve problems

## **11.0 MODERN PHYSICS**

- 11.1 Explain Photo-electric effect
- 11.2 Einstein 's photoelectric equation
- 11.3 State laws of photoelectric effect
- 11.4 Working of photoelectric cell
- 11.5 Applications of photoelectric effect
- 11.6 Recapitulation of refraction of light and its laws
- 11.7 Critical angle
- 11.8 Total Internal Reflection
- 11.9 Explain the principle and working of Optical Fiber
- 11.10 Mention types of optical fibbers
- 11.11 List the applications of Optical Fiber
- 11.12 Definition of super conductor and superconductivity\
- 11.13 Examples of superconducting materials
- 11.14 Properties of Superconductors
- 11.15 Applications of superconductors

## **COURSE CONTENTS**

### **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- - Problems.

## **2. ELEMENTS OF VECTORS:**

Scalars and Vectors –Types of vectors- Addition of vectors- Representation of vectors- Resolution of vectors - Parallelogram, Triangle and Polygon laws of vectors– Dot and Cross products of vectors-Problems

## **3. KINEMATICS:**

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 and resultant velocity- problems

## **4. FRICTION:**

Introduction to friction- Causes- Types of friction- Laws of friction- Angle of repose- Angle of friction-- Motion of a body over a horizontal surface- smooth inclined plane- 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- Conservation law of energy- Conventional and Non conventional energy sources-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- Experimental determination of acceleration due to gravity-seconds pendulum- Problems

## **7. HEAT AND THERMODYNAMICS:**

Expansion of Gases- Boyle's law-Experiment of Boyle's law- Absolute scale of temperature- Charles laws- Ideal gas equation- Universal gas constant-Differences between  $r$  and  $R$ - Internal energy-External work done by a gas- Isothermal and adiabatic processes- Laws of thermodynamics- Two specific heats of a gas- Relation between  $C_p$  and  $C_v$ - Problems

## **8. SOUND:**

Sound- Nature of sound- Musical sound and noise- Noise pollution – Causes & effects- Methods of reducing noise pollution- Beats- Doppler effect- Echo- Reverberation- Reverberation time-Sabine 's formula- Problems

## **9. PROPERTIES OF MATTER:**

Introduction to Elasticity- Stress and Strain- Hooke's law- Types of Stress and Strain- Types of moduli of elasticity- Introduction to Surface Tension- Definition and examples- Molecular theory- Angle of contact and capillarity- Experimental determination of surface tension by capillary method- Effects of temperature and impurities- Introduction to Viscosity- Definition and examples- Newton's formula for viscosity- Experimental determination of viscosity by Poiseuille's method- Effect of temperature- 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-critical angle – Total internal reflection- fiber optics- -principle and working of an optical fiber-types of optical fibers - Applications of optical fibers- concepts of superconductivity - applications

#### Reference Books

- |    |  |                            |
|----|--|----------------------------|
| 1. | Intermediate Physics Volume 1 and 2          | Telugu academy.            |
| 2. | Intermediate Physics Volume 1 and 2          | Deepthi Publications       |
| 3. | Unified Physics Volume 1,2,3 and 4<br>Gupta. | Dr. S.L. Gupta and Sanjeev |
| 4. | Text book of Physics Volume 1 and 2          | Resnik and Halliday        |
| 5. | Text book of applied physics                 | Dhanpath Roy               |
| 6. | Fiber optics                                 | D.A. Hill                  |
| 7. | Engineering Physics                          | M. Raghavendra             |



**ENGINEERING CHEMISTRY & ENVIRONMENTAL STUDIES**  
(Common Subject)

Subject Title	:	Engineering Chemistry & Environmental studies
Subject Code	:	M-104
Periods per week	:	04
Total periods per year	:	120

**TIME SCHEDULE**

S.No	Major Topic	No. of Periods	Weightage of Marks	No. of Short Questions	No. of Essay Questions
<b>I.</b>	<b>ENGINEERING CHEMISTRY</b>				
1.	FUNDAMENTALS OF CHEMISTRY	18	16	2	1
2.	SOLUTIONS	10	08	1	½
3.	ACIDS AND BASES	10	08	1	½
4.	PRINCIPLES OF METALLURGY	10	10	-	1
5.	ELECTROCHEMISTRY	12	13	1	1
6.	CORROSION	09	10	-	1
7.	WATER TECHNOLOGY	13	13	1	1
8.	POLYMERS	12	13	1	1
9.	FUELS	08	03	1	-
<b>II.</b>	<b>ENVIRONMENTAL STUDIES</b>	18	16	2	1
	Total	120	110	10	08

**OBJECTIVES:** After the completion of the study of these units the student should be able to comprehend the following

**I. ENGINEERING CHEMISTRY**

**1.0 Fundamentals of Chemistry**

Atomic Structure:

- 1.1 Fundamental particles of an atom
- 1.2 Understand the concept of atomic number and mass number
- 1.3 Postulates of BOHR'S atomic theory and its limitations
- 1.4 Briefly explain Quantum numbers
- 1.5 Define and explain Aufbau principle, Hund's rule and Pauli's exclusion principle.
- 1.6 Define Orbital
- 1.7 Draw the shapes of s, p and d Orbitals
- 1.8 Distinguish between Orbit and Orbital
- 1.9 Understand electronic configuration of elements (up to element atomic number 30)

Periodic Table

- 1.10 State modern periodic law
- 1.11 Salient features of modern periodic Table (Periods & Groups)

## Chemical bonding

- 1.12 Introduction
- 1.13 Postulates of Electronic theory of valency
- 1.14 Types of Chemical bonds
- 1.15 Define ionic bond and explain ionic bond formation in NaCl and MgO
- 1.16 Properties of Ionic compounds
- 1.17 Define covalent bond and explain Covalent bond in H<sub>2</sub>, O<sub>2</sub> and N<sub>2</sub> using Lewis dot method.
- 1.18 Properties of Covalent compounds
- 1.19 Explain Metallic bond

## Oxidation-Reduction:

- 1.20 Definition of Oxidation and Reduction
- 1.21 Definition of Oxidation Number and its calculations
- 1.22 Difference between Oxidation Number and Valency

## **2.0 Solutions**

- 2.1 Define Solution, solute and solvent
- 2.2 Types of solutions
- 2.3 Define mole and understand Mole concept
- 2.4 Define and explain Molarity
- 2.5 Define and explain Normality
- 2.6 Define and explain equivalent weight using acids, bases and salts
- 2.7 Numerical problems on Mole, Molarity and Normality

## **3.0 Acids and bases**

- 3.1 Explain Arrhenius theory of Acids and Bases and its limitations
- 3.1 Explain Bronsted – Lowry theory of acids bases and its limitations
- 3.2 Explain Lewis theory of acids and bases and its limitations
- 3.3 Explain Ionic product of water
- 3.4 Define pH and explain Sorenson scale
- 3.5 Numerical problems on pH (Strong Acids and Bases)
- 3.6 Define buffer solution with examples
- 3.7 Applications of buffer solutions

## **4.0 Principles of Metallurgy**

- 4.1 Characteristics of Metals
- 4.2 Distinction between Metals and Non Metals
- 4.3 Definitions of Metallurgy, Mineral, Ore, Gangue, Flux and Slag
- 4.4 Methods of concentration of ore – Hand picking, Levigation, Froth Floatation
- 4.5 Extraction of crude metal – Roasting, Calcination, Smelting
- 4.6 Purification of Metals – Electrolytic Refining
- 4.7 Define an Alloy
- 4.8 Composition and uses of following Alloys: Brass, German silver, Nichrome

## **5.0 Electrochemistry**

- 5.1 Define conductor Insulator, Electrolyte and Non – electrolyte
- 5.2 Explain Arrhenius theory of electrolytic dissociation
- 5.3 Define and explain electrolysis by taking example fused NaCl
- 5.4 Explain Faraday's laws of electrolysis
- 5.5 Define chemical equivalent and electrochemical equivalent
- 5.6 Numerical problems based on Faraday's laws of electrolysis
- 5.7 Define Galvanic cell and explain its construction

- 5.8 Distinguish between electrolytic cell and galvanic cell
- 5.9 Understand the standard electrode potentials
- 5.10 Understand electrochemical series and its significance
- 5.11 Understand emf of a cell
- 5.12 Numerical problems on emf of cell

## **6.1 Corrosion**

- 6.1 Define corrosion
- 6.2 Factors influencing the rate of corrosion
- 6.3 Understand the concept of electrochemical theory of corrosion
- 6.4 Describe the formation of a) composition cells b) stress cells c) concentration cells
- 6.5 Understand rusting of iron
- 6.6 Explain the mechanism of rusting of iron
- 6.7 Explain the methods of prevention of corrosion a) protective coatings b) cathodic protection (Sacrificial anode process and Impressed – voltage process)

## **7.0 Water Technology**

- 7.1 Sources of water
- 7.2 Define soft and hard water
- 7.3 Understand temporary and permanent hardness and the compounds causing hardness (with Formulae)
- 7.4 State the disadvantages of using hard water in industries
- 7.5 Define Degree of hardness, units of hardness (ppm)
- 7.6 Explain the methods of softening of hard water: a) permutit process b) ion-Exchange process
- 7.7 Know the essential qualities of drinking water
- 7.8 Describe the method of municipal treatment of water for drinking purpose.
- 7.9 Explain Osmosis and Reverse Osmosis. Advantages of Reverse Osmosis

## **8.0 Polymers**

- 8.1 Basic concepts of polymerisation
- 8.2 Describe the methods of polymerisation a) addition polymerisation of Ethylene b) condensation polymerisation of phenol and formaldehyde (Only flow chart i.e. without chemical equations)
- 8.3 Define the term plastic
- 8.4 Classification of plastics with examples
- 8.5 Distinguish between thermo and thermosetting plastics
- 8.6 Characteristics of plastics
- 8.7 Advantages of plastics over traditional materials
- 8.8 Disadvantages of using plastics.
- 8.9 Methods of preparation and uses of the following plastics: 1. Polythene 2. PVC 3. Teflon 4. Polystyrene 5. Urea formaldehyde
- 8.10 Know the term natural rubber
- 8.11 State the structural formula of Natural rubber
- 8.12 Explain the processing of Natural rubber from Latex
- 8.13 Characteristics of natural rubber
- 8.14 Explain the process of Vulcanization
- 8.15 Characteristics of Vulcanized rubber
- 8.16 State the term Elastomer
- 8.17 Describe the preparation and uses of the following synthetic rubbers a) Buna-s b) Neoprene rubber

## **9.0 Fuels**

- 9.1 Define the term fuel
- 9.2 Classification of fuels based on physical state – solid , liquid and gaseous fuels, and based on occurrence- primary and secondary fuels
- 9.3 Understand characteristics of good fuel
- 9.4 Extraction and Refining of Petroleum
- 9.5 State the composition and uses of gaseous fuels: a) water gas b) producer gas c) natural gas d) coal gas e) Bio gas f) acetylene

## **II. ENVIRONMENTAL STUDIES**

- 1.1 Define terms environment and environmental studies. explain the scope and importance of environmental studies
- 1.2 Understand the terms – lithosphere, hydrosphere, atmosphere, biosphere, biotic component, energy component, pollutant, pollution, contaminant receptor - sink, particulates, dissolved oxygen, Threshold limit value, BOD, COD
- 1.3 Define air pollution
- 1.4 Classification of air pollutants- based on origin and state of matter
- 1.5 State and explain the causes of air pollution
- 1.6 Explain the use and over exploitation of forest resources and deforestation
  
- 1.7 Explain the effects of air pollution on human beings, plants and animals
- 1.8 Explain the green house effect- ozone layer depletion and acid rain
- 1.9 Understand the methods of control of air pollution
- 1.10 Define water pollution
- 1.11 Explain the causes of water pollution
- 1.12 Explain the effects of water pollution on living and non living things
- 1.13 Understand the methods of control of water pollution
- 1.14 knows growing energy needs renewable and non-renewable energy sources.  
Understand the use of alternate energy sources
- 1.15 Define an Ecosystem
- 1.16 Define producers, consumers and decomposers with examples.
- 1.17 Define biodiversity and threats to biodiversity

## COURSE CONTENTS

### I ENGINEERING CHEMISTRY

#### 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

**Periodic Table:** Modern Periodic Law, salient features of Modern Periodic Table

**Chemical Bonding:** Introduction – types of chemical bonds – Ionic and covalent bond with examples – Properties of Ionic and Covalent compounds – Metallic bond

**Oxidation-Reduction:** Concepts of Oxidation-Reduction, Oxidation Number -calculations, differences between Oxidation Number and Valency

#### 2. Solutions

Introduction-concentration methods – Mole concept, Molarity, Normality, Equivalent weights, 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 -  $P^H$  and related numerical problems – buffer solutions –Applications.

#### 4. Principles of Metallurgy

Characteristics of Metals and distinctions between Metals and Non Metals, Metallurgy, ore, Gangue, Flux, Slag - Concentration of Ore –Hand picking, Levigation, Froth floatation – Extraction of crude Metal – Roasting, Calcination, Smelting – Alloys – Composition and uses of Brass, German silver and Nichrome

#### 5. Electrochemistry

Conductors, insulators, electrolytes - Arrhenius theory of electrolytic dissociation – electrolysis – Faraday's laws of electrolysis- numerical problems – Galvanic cell – standard electrode potential – electro chemical series –emf and numerical problems on emf of a cell

#### 6. Water technology

Introduction –soft and hard water – causes of hardness – types of hardness – disadvantages of hard water – degree of hardness (ppm) – softening methods – permutit process – ion exchange process – numerical problems related to degree of hardness – drinking water – municipal treatment of water for drinking purpose – Osmosis, Reverse Osmosis - advantages of Reverse osmosis

#### 7. Corrosion

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

## 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: 1. Polyethylene 2. PVC 3. Teflon 4. Polystyrene 5. Urea formaldehyde – Rubber – Natural rubber – processing from latex –Vulcanization – Elastomers – Buna-s, Neoprene rubber and their uses.

## 9. Fuels

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

## II. ENVIRONMENTAL STUDIES

Introduction – environment –scope and importance of environmental studies important terms – air pollution - causes-Effects – forest resources : uses and over exploitation, deforestation, acid rain, green house effect –ozone depletion – control of air pollution – Water pollution – causes – effects – control measures, renewable and non renewable energy sources – Concept of ecosystem, producers, consumers and decomposers – Biodiversity, definition and threats to Biodiversity.

### Reference books

- |                                     |  |
|-------------------------------------|--|
| 1. Intermediate Chemistry Vol 1 & 2 | Telugu Academy                         |
| 2. Intermediate Chemistry Vol 1 & 2 | Vikram Publishers                      |
| 3. Intermediate Chemistry Vol 1 & 2 | Vignan Publishers & Deepthi publishers |
| 4. Engineering Chemistry            | Jain and Jain                          |
| 5. Engineering Chemistry            | O.P.Agarwal, Hi-Tech.                  |
| 6. Engineering Chemistry            | M.S.N.Raju, etc, Hi-Tech.              |
| 7. Applied Chemistry                | V.Subrahmanyam                         |
| 8. Engineering Chemistry            | Sharma                                 |
| 9. Environmental chemistry          | A.K. De                                |
| 10.Engg. Chemistry & Env. Studies   | Dr. G. Venkatanarayana                 |

## WORKSHOP TECHNOLOGY

Subject Title	:	Workshop Technology
Subject Code	:	M - 105
Periods/Week	:	05
Periods Per Year	:	150

### TIME SCHEDULE

S. No	Major Topics	No. of Periods	Weightage of marks	Short Answer Questions	Essay type Questions
1.	Basic Workshop tools & operation, Its introduction	04	03	1	-
	(a) Carpentry	20	13	1	1
	(b) Fitting	20	13	1	1
	(c) Forging	20	13	1	1
	(d) Sheet Metal	20	13	1	1
2.	Foundry	20	19	3	1
3.	Drilling	18	13	1	1
4.	Sawing	10	10	-	1
5.	Mechanical Working of Metals	18	13	1	1
	<b>Total</b>	150	110	10	08

### OBJECTIVES

*On completion of the study of the subject a student will be able to comprehend the following*

#### 1. Basic Workshop Tools and Operation

- 1.1. State the importance of workshop processes.
- 1.2. List the various Workshop processes and explain briefly about each.

#### 2. Carpentry

- 2.1. To identify various carpentry tools.
- 2.2. To distinguish between marking Tools, Cutting Tools and measuring Tools.
- 2.3. To identify work holding devices.
- 2.4. To explain a few wood working processes viz., sawing, planning and chiselling.
- 2.5. To describe the use of Carpentry joints such as lap, dovetail Joint, Mortise and Tenon Joint.

#### 3. Fitting

- 3.1. To identify various fitting tools.
- 3.2. To distinguish between marking and measuring tools.
- 3.3. To identify cutting tools.
- 3.4. To identify work holding devices in fitting.

3.5. To explain a few fitting operations such as marking chipping, filing, grinding, sawing, drilling and tapping.

#### **4. Forging**

- 4.1. To identify various tools used in black-smithy.
- 4.2. To list out equipment in a forge shop.
- 4.3. To describe the important smithy operations.
- 4.4. To describe the working principles of machine forging using forging hammers.
- 4.5. To explain a few machine forging operations such as drawing, upsetting and punching.
- 4.6. To understand the forging press.

#### **5. Sheet Metal**

- 5.1. To identify various marking tools in sheet metal work.
- 5.2. To identify few types of stakes.
- 5.3. To identify various measuring tools used in sheet metal work.
- 5.4. To identify various sheet metal joints.
- 5.5. To describe few sheet metal operations such as shearing, bending, drawing and squeezing.
- 5.6. To differentiate between riveting, soldering & brazing.

#### **6. Foundry**

- 6.1. Acquaints with foundry as a manufacturing Process.
- 6.2. State the advantages of casting over other Processes.
- 6.3. State the limitations of the process.
- 6.4. List various hand moulding tools.
- 6.5. State the properties of a good moulding Sand.
- 6.6. State the types of moulding sands.
- 6.7. List the ingredients in foundry sand.
- 6.8. List the various types of patterns.
- 6.9. State the sequence of pattern making operation given a blue print of a pattern.
- 6.10 Identify the colour codes.
- 6.11 List out the various moulding process.
- 6.12 State the need of cores.
- 6.13 List the types of cores.
- 6.14 Describe the casting processes.
- 6.15 Identify the defects, its causes and remedies in casting.
- 6.16 Describe special casting processes.

#### **7. Drilling**

- 7.1. State the working principle of drill work.
- 7.2. List out different types of drilling machines.
- 7.3. Draw the line diagrams of the sensitive and radial drilling machines.
- 7.4. Identify the parts of these machines.
- 7.5. Describe the functions of each part.
- 7.6. Specify the standard dimensions of machines.
- 7.7. Write the Nomenclature of the drill bit.
- 7.8. Write the Geometry of twist drill.
- 7.9. List the Functions of twist drill elements.
- 7.10. List different operations on drilling machine.



## 8. Sawing

- 8.1. Differentiate between hand sawing and machine sawing.
- 8.2. Classify the metal sawing machines.
- 8.3. Illustrate the working principle of sawing machines viz., reciprocating and band type.
- 8.4. Give saw teeth nomenclature.
- 8.5. Describe the working of different saws.

## 9. Mechanical working of Metals

- 9.1. Briefly explain mechanical properties of metals.
- 9.2. Define mechanical working of metals.
- 9.3. Differentiate cold working with hot working.
- 9.4. Illustrate the working principle of hot rolling, piercing, spinning, extrusion and drawing.
- 9.5. State advantages and limitations of hot working.
- 9.6. Identify various cold working processes such as rolling, bending and squeezing.
- 9.7. State advantages and limitations of cold working.

## COURSE CONTENTS

### 1.0 Introduction

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

### 1.1 Carpentry

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, spirit level, plum bob, specifications- uses.

#### ***Cutting Tools***

**Saws:** Ripsaw, cross cut saw (Hand saw) Panel saw, Tenon or back saw, Dovetail saw, Bow saw, Copying saw, compass saw, pad or keyhole saw, specifications & uses.

**Chisels:** Firmer chisel, Beveled Edge firmer chisel, Parting chisel, Mortise chisel, inside and outside gauges, specifications and uses.

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

#### **Boring Tools**

Gimlet, brace, wheel brace, Ratchet brace, Bit-shell bit, twist bit (Auger bit); expansive bit, centre bit, router bit, countersink bit, drill, reamer their specifications & uses.

#### **Striking tools**

Hammers - Warrington hammer, Claw hammer, Mallet, Specifications & uses.

#### **Holding devices**

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

### **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.

### **Carpentry Processes**

Marking, sawing, planning, chiselling, boring, Grooving, Rebating & moulding.

### **Carpentry joints**

Halving Joint, Mortise and Tenon Joint, Bridle Joint, Butt Joint. Dowel Joint, Tongue & Groove Joint, Screw & Slot Joint, Dovetail Joint, Corner Joint.

### **Wood working machines**

Wood working lathe (Wood turning lathe), Circular saw, Band saw, Wood planer, Sanding machine, belt sander, Spindle sander and disc sander, grinder and their specifications and uses.

## **1.2 Fitting**

### **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 and sizes & shapes - flat file, hand file, square file, pillar file, round file, Triangular file, half round file, knife edge file, needle file - specifications uses.

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

**Saws :**Hacksaw, solid frame, adjustable frame, specifications & uses. Hand hacksaw blades, power hacksaw blade. Specifications and uses.

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

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

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

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

### **Striking Tools**

**Hammers:** hammer-parts, ball peen, cross peen, straight peen hammers, soft hammer, sizes, specifications and uses.

### **Holding Devices**

Vice-Bench vice, leg-vice, hand vice, pin vice. Tool maker's vice, pipe vice, care of vices, specifications and uses.

### **Marking Tools**

Surface plate, V-block, Angle plate, try square, scribe, punch prick punch, centre punch, number punch, letter punch, specifications and uses.

### **Miscellaneous Tools**

Screw drivers, spanners, single ended & double ended, box type, adjustable spanners, cutting pliers, nose pliers, Allen keys, specifications and uses.

### **Checking and Measuring Instruments**

Checking instruments.

**Callipers:** Outside & Inside callipers with firm joint, spring callipers - Hermaphrodite (Odd leg) calliper. Transfer Calliper sizes & uses.

### **Dividers - Sizes & uses.**

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.

### **Fitting Operations**

Chipping, filing, scrapping, grinding, sawing, marking, drilling reaming, tapping and dieing.

## **1.3 Forging**

### **Hand forging**

**Hand tools:** Anvil, swage block, Hand hammers - types; sledge hammers, specifications and uses.

Tongs, types of specifications & uses.

Chisel-Hot & cold - Specifications & uses.

Swages - types and sizes.

Fullers, flatters, set hammer, punch and drift sizes and uses.

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

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

### **Machine Forging**

Introduction - Need of machine forging, forging parts.

Forging hammers: Spring hammers, pneumatic hammers, steam hammers, Drop hammers.

Forging press: Hydraulic press - line diagram.

Machine forging operations - Drawing, Upsetting & Punching.

Tools used in machine forging.

## **1.4 Sheet Metal Work (Tin smithy)**

Metals used for sheet metal work.

Sheet metal hand tools:

**Measuring tools** - steel rule, circumference rule, thickness gauge, sheet metal gauge, straight edge, scribe, 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, Hatches stake, needle stake, Blow Horn stake, Hollow mandrel stake, pliers (Flat nose and round nose) Grocers and rivet sets, soldering iron, common forms-specifications & uses of above tools.

### **Sheet Metal Operations**

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

**Bending:** Single bend, double bend, straight flange, edgehem, embossing, beading, double hem or lock seam.

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

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

### **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.

## **Fastening Methods**

Rivetting, soldering, brazing & spot welding.

### **2.0 Foundry.**

- 2.1 Introduction : Development of foundry as a manufacturing process : Advantages and limitations of casting over other manufacturing processes.
- 2.2 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.
- 2.3 Sands : Properties of moulding sand porosity, flow ability, collapsibility, adhesiveness, cohesiveness and refractoriness.
- 2.4 Types of moulding sand : Green sand, dry sand, loam sand, facing sand, backing sand, parting sand, core sand, system sand, their ingredients and use.
- 2.5 pattern making : Materials such as Wood, Cast Iron, Aluminium, Brass, Plastics their uses and relative advantage.  
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.
- 2.6 Cores - Need of cores, types of cores.
- 2.7 Casting : green sand and dry sand moulding - Cement bonded moulding, shell moulding - Ceramic moulding - Defects in castings, its causes and their remedies.
- 2.8 Special casting processes : (Principles and applications only) Die Casting - Centrifugal casting - CO<sub>2</sub> process, investment casting..

### **3.0 Drilling**

- 3.1 Type of drilling machines: sensitive & Radial and their constructional detail and specifications.
- 3.2 Drill bits - Terminology - Geometry of twist drill - Functions of drill elements.
- 3.3 Operations: Drilling, reaming, boring, counter boring, counter sinking, tapping, spot facing-trepanning, gang drilling.

### **4.0 Sawing: Introduction**

- 4.1 Hand sawing - Power sawing.
- 4.2 Metal sawing machines: Reciprocating saws (vertical and Horizontal) saws, Band saws, constructional details and specifications of the above.
- 4.3 Metal Saw - blades - Types - Angles of saw - teeth set - Saw material.

### **5.0 Mechanical working of metals**

- 5.1 Brief explanation of mechanical properties of metals
- 5.2 Introduction to Hot working and cold working.
- 5.3 Hot working processes Rolling: Types of rolling, two high mill, three high mill, four high mill.  
Piercing or seamless tubing drawing or cupping, spinning Extrusion. Direct or forward extrusion, indirect or backward extrusion, tube extrusion, Impact extrusion.

- 5.4 Effects of hot working of metals. Advantages & limitations of hot working of metals.
- 5.5 Cold working process:
  - Rolling: Drawing - wire drawing, tube drawing.
  - Bending: Roll forming, angle bending, spinning, extrusion, squeezing, cold heading thread rolling, peening.
- 5.6 Effects of Cold working of metals, advantages & limitations of cold working.

## REFERENCE BOOKS

- 1. Production Technology by Jain & Gupta
- 2. Elementary Workshop Technology by Hazra Chowdary & Bhattacharya
- 3. Workshop Technology Vol I & II by Raghuvamshi
- 4. Manufacturing Science by Suresh Dehela.
- 5. Production Technology by RB Gupta

## WORKSHOP PRACTICE-I

<b>Subject Title</b>	:	<b>Workshop Practice-I</b>
<b>Subject Code</b>	:	<b>M – 106</b>
<b>Periods/Week</b>	:	<b>06</b>
<b>Periods Per Year</b>	:	<b>180</b>

*The following exercises are to be completed in a year*

### **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 chiseling of wood.
4. Orientation of wood grain.
5. Preparation of dovetail joint.
6. Mortise and tenon joint.
7. Wood turning on a lathe, preparation two jobs using wood working lathe.
8. Preparation of drawing stool.

### **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.

### **FOUNDRY**

Moulding and casting of

1. Solid bearing
2. Flange coupling
3. Split bearing
4. Connecting rod
5. V – Pulley
6. Gear pulley

## ENGINEERING DRAWING

**Subject Title** : **Engineering Drawing**  
**Subject Code** : **M- 107**  
**Periods/Week** : **06**  
**Periods Per Year** : **180**

### TIME SCHEDULE

S. No	Major Topics	Periods	Weightage of marks	Short Type Questions	Essay Type Questions
1	Importance of Engineering Drawing	03	-	-	-
2	Drawing instruments				
3	Free hand lettering & Numbering	06	5	1	-
4	Dimensioning Practice	12	5	1	-
5	Geometrical construction	24	10		1
6	Projection of points, Lines, Planes and solids	30	10	-	1
7	Orthographic Projection	30	15	1	1
8	Sectional views	18	10		1
9	Auxiliary views	06	5	1	
10	Pictorial drawing	30	10	-	1
11	Development of surfaces	21	10	-	1
<b>Total</b>		<b>180</b>	<b>80</b>	<b>04</b>	<b>06</b>

### OBJECTIVES

On completion of the study of this subject the student should be able to

#### 1.0 Understand the Importance of Engineering Drawing

- 1.1 State the importance of drawing as an engineering communication medium.
- 1.2 State the necessity of I.S. Code of practice for Engineering Drawing.
- 1.3 Appreciate the linkages between Engineering drawing and other subjects of study in Diploma course.

#### 2.0 Use Engineering Drawing Instruments

- 2.1 Select the correct instruments and draw lines of different orientation.
- 2.2 Select the correct instruments and draw small and large Circles.
- 2.3 Select the correct instruments for measuring distances on the drawing.
- 2.4 Use correct grade of pencil for different types of lines, thickness and given function.
- 2.5 Select and use appropriate scales for a given application.
- 2.6 Identify different drawing sheet sizes as per I.S. and Standard Lay-outs.
- 2.7 Prepare Title block as per I.S. Specifications.

2.8 Identify the steps to be taken to keep the drawing clean and tidy.

### **3.0 Write Free Hand Lettering and Numbers**

3.1 Write titles using sloping lettering and numerals as per B.I.S (Bureau of Indian standards)

3.2 Write titles using vertical lettering and numerals as per B.I.S.

3.3 Select suitable sizes of lettering for different layouts and applications.

3.4 Make the use of lettering stencils.

### **4.0 Understand Dimensioning Practice**

4.1 State the need of dimensioning the drawing according to accepted standard.

4.2 Define "Dimensioning".

4.3 Identify notations of Dimensioning used in dimensioned drawing.

4.4 Identify the system of placement of dimensions in the given dimensioned drawing.

4.5 Dimension a given drawing using standard notations and desired system of dimensioning.

4.6 Dimension standard features applying necessary rules.

4.7 Arrange dimensions in a desired method given in a drawing.

4.8 Identify the departures if any made in the given dimensioned drawing with reference to SP-46-1988, and dimension the same correctly.

### **5.0 Apply Principles Of Geometric Constructions**

5.1 Divide a given line into desired number of equal parts internally.

5.2 Draw tangent lines and arcs.

5.3 Construct a Hexagon from the given data.

5.4 Define ellipse, parabola hyperbola, involute, cycloid, and helix.

5.5 Construct ellipse by concentric circles method and using a paper trammel.

5.6 Construct parabola, rectangular hyperbola involute, cycloid and helix from the given data.

5.7 State the applications of the above constructions in Engineering practice.

### **6.0 Apply Principles of Projection of points, lines & planes**

6.1 Explain the projection of a point with respect to reference planes (HP & VP)

6.2 Explain the projections of straight lines with respect to two reference planes.

6.3 Explain the projections of perpendicular planes.

### **7.0 Apply principles of Orthographic Projection**

7.1 Explain the principles of Orthographic projection with simple sketches.

7.2 Prepare an Engineering Drawing of a given simple Engineering part in first angle projection.

7.3 Draw the orthographic view of an object, given its pictorial drawing.

7.4 Sketch the minimum number of views needed to represent a given object fully.

7.5 identify the object, from a number of orthographic views given.

7.6 Supply the missing view when given two other views of an object.

### **8.0 Appreciate the need of Sectional Views**

8.1 Explain the need to draw sectional views.



- 8.2 Select the section plane for a given component to reveal maximum information.
- 8.3 Draw sectional view for the component in 8.2.
- 8.4 Apply conventional practices and identify the parts, which should not be shown in section while drawing sectional views.
- 8.5 Make conventional representation of Engineering materials as per latest B.I.S. Code.
- 8.6 Apply principles of hatching.
- 8.7 Draw simple sections (full, half, revolved and removed part) for a range of simple Engineering objects.
- 8.8 Draw the component from a given set of sectional views.

### **9.0 Understand the need for Auxiliary Views**

- 9.1 State the need of Auxiliary views for a given Engineering Drawing.
- 9.2 Sketch the auxiliary views of a given Engineering component to indicate the true shape and size of component.
- 9.3 Draw the auxiliary views of a given Engineering drawing.

### **10.0 Prepare Pictorial Drawings**

- 10.1 State the need for commonly used type of pictorial drawings.
- 10.2 Given the objects, draw their orthographic views.
- 10.3 State the need of isometric scale and isometric projection.
- 10.4 Prepare Isometric projections for the given orthographic drawings.
- 10.5 Prepare oblique drawing cavalier, cabinet of simple Engineering objects from the given data.
- 10.6 Identify the correct pictorial views from a set of Orthographic drawings.

### **11.0 Prepare Development Drawings**

- 11.1 State the need for preparing development drawing.
- 11.2 Prepare development of simple Engineering objects using parallel line and radial line method.
- 11.3 Prepare development of Surface of Engineering components like trays, funnel, 90° elbow & rectangular duct.

## **COURSE CONTENTS**

### **NOTE**

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

### **Understand 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 of I.S.O and B.I.S-Role of drawing in -engineering education

Link between Engineering drawing and other subjects of study.

### **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, To draw "Lay out of sheet " – and as per SP-46-1988 to a suitable scale.  
Simple Exercises on the use of Drawing Instruments.  
Importance of Title Block.

**Drawing Plate 1: (Consisting of about two exercises)**

To draw geometric shapes (standard) using drawing instruments -To draw layout of sheet and title block.

**Free hand lettering & numbering**

Importance of lettering – Types of lettering  
Guide Lines for Lettering  
Recommended sizes of letters & numbers –  
Advantages of single stroke or simple style of lettering –  
Use of lettering stencils

**Drawing plate 2: (Consisting of about 5 to 6 exercises)**

To print the table of Types of lines as per latest ISI Standards.  
To print the table of "Recommended sizes of letters and numerals" – as per Standards.  
Selection of suitable size of letters and numbers and draw the given titles, phrases using both vertical and sloping styles.

**Dimensioning practice**

Purpose of engineering Drawing, need of I.S.I 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.

**Drawing Plate 3: (Consisting of above 12 to 15 exercises)**

Dimensioning a given drawing using the above tools, rules and systems of dimensioning.  
Dimensioning practice in various methods of dimensioning stated above.  
Dimensioning, given common features listed.  
Exercise in identifying the departures made in a given dimensioned drawing from I.S.I. Code of practice.

**Geometric Construction**

**Division of a line:** to divide a straight line into given number of equal parts

internally examples in Engineering application.

**Construction of tangent lines:** to draw tangent lines touching circles internally and externally.

**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.

**Hexagon:** Inscribing a Hexagon in a circle of given dia and circumscribing a given circle, using

- i) Set squares.
- ii) Compass – given a side to construct a Hexagon using set squares or compass.

**Conical Curves:** Explanation of Ellipse, Parabola, Hyperbola, as sections of a double cone and a loci of a moving point, Eccentricity of above curves – Their Engg. Application viz. Bolts and Nuts, Projectiles, reflectors P.V. Diagram of a Hyperbolic process, Construction of Ellipse using.

- i) Concentric circles method.
- ii) Paper trammel, method.
- iii) Construction of parabola by rectangular method.
- iv) Construction of Rectangular Hyperbola when given the position of a point on the curve.

**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:

#### **Drawing Plate: 4 (Consisting of about 12 to 15 exercises)**

Exercises mentioned above at the rate of at least one problem on each “construction”.

#### **Projection of points, lines and planes.**

Projecting a point on two planes of projection

Projecting a point on three planes of projection

Projection of straight line.

- (a) Parallel to one or both the planes.
- (b) Contained by one or both the planes.
- (c) Perpendicular to one of the planes.
- (d) inclined to one plane and parallel to other planes.

Projection of perpendicular planes

- (a) Plane perpendicular to both HP and VP
- (b) Plane perpendicular to HP and parallel to VP and Vice versa.
- (c) Plane perpendicular to HP and inclined to VP and vice versa.

Projection of Regular solids in simple positions

#### **Orthographic Projections**

Meaning of Orthographic Projection -Using a viewing Box and a model – Number of views obtained on the six faces of the box, - Neat sketches of only 3 views for describing object -Concept of front view, top views, and sides 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.

**Drawing Plate 5: (Consisting of about 10 to 12 Number of exercises)**

Given an engineering object(s) to sketch the three views.

Given the pictorial view of simple objects to sketch the three views in

First and third angle projections.

Given the object (pictorial Drawing) and 3 views identifying the surface on the views with reference to the object.

Given two views and a simple object – Draw the missing third view.

**Drawing Plate 6: (Consisting of about 6 to 8 exercises)**

Given the engineering objects (Pictorial views) Drawing the three views in First angle projection.

Identifying the object, when given a number of objects and the orthographic views (matching exercises).

**Sectional views**

Need for drawing sectional views – what is a sectional view - Location of cutting plane – Purpose of cutting plane line – Selection of cutting plane to give maximum information (vertical and offset planes) -Meaning of Full, half revolved and removed, local or partial sections - Hatching – adjacent components (two or more) large areas, a part in different parallel planes-Conventional practices to represent sections of ribs, shafts, bolts, nuts, screws, rivets, spokes, webs, keys, cotters, thin sections etc., as per B.I.S. specifications – Conventional representation of materials as per B.I.S. Standards.

**Drawing Plate 7: (Consists of about 8 to 10 exercises)**

Preparing conventional representation of a materials as per latest/ B.I.S. Code.

Given the object (pictorial or orthographic view), and cutting plane line to draw sectional view.

Given the object to select the correct cutting plane line and then to draw the sectional view.

To identify the object when given number of objects and number of sectional views (Matching exercise.)

**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.

**Drawing plate No.8: (Consisting of about 8 exercises)**

Given a set of objects, state whether an auxiliary view is needed – if required sketch the same.

Given the object and its auxiliary view (partial or full, to sketch the auxiliary plane on the pictorial view)

**Pictorial Drawings**

Brief description of different types of pictorial drawing viz., Isometric, oblique,

and perspective – Use of these - Isometric drawings: Iso axis, angle between them, meaning of visual distortion in dimensions - Need for an isometric scale, difference between Isometric scale, and ordinary scale difference between Isometric drawing (or view, and Isometric Projection) and orthographic drawing - Isometric and non-Isometric lines -Isometric drawing of common features like rectangles, circular - shapes, non-isometric lines, Use of box and offset construction -Oblique drawings: Their use -Cavalier and cabinet drawings – Oblique drawing of common features like rectangular, circular and inclined, surfaces -Selection of the face of the object to be included in the front view.

### **Draw plate 9: (Consists of about 10 to 12 exercises)**

Given the Orthographic views to draw isometric views,

Construction of isometric scale.

Given the Orthographic views to draw isometric Projections.

Given the Orthographic views to draw cavalier Drawings.

Given the Orthographic views to draw cabinet Drawings.

### **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) When it is inclined to one principal and parallel to the other -Development of simple Engineering common solids like Cubes, prisms, Cylinders, Cones, Pyramid (sketches only) -Types of Development: Parallel line and radial line development -Procedure of drawing development, drawings of trays funnels, 90<sup>0</sup> elbow pipes and rectangular ducts.

### **Drawing plate No. 10: (Consists of about 10 exercises)**

Development drawings by “ Parallel – line “ method such as prisms and Cylinders (Truncated).

Development drawing by “Radial – line “ method such as cones and pyramids ( Truncated)

Development drawings of a tray: funnel 90<sup>0</sup> elbow and rectangular duct.

### **REFERENCE BOOKS**

- First Year Engineering Drawing – B.R. Gupta.
- Engineering Drawing by N.D.Bhatt.
- “A First Year Engineering Drawing” – A.C. Parkinson (Metric Edition).
- T.S.M. & S.S.M on “ Technical Drawing” prepared by T.T.T.I., Madras.
- SP-46-1998 – Bureau of Indian Standards.
- Engineering Drawing with AutoCAD by Prof. B.V.R. Gupta- I.K. International publishing house (pvt.) Ltd.,

**PHYSICS LABORATORY**  
**(Common to All Courses)**

<b>Subject title</b>	<b>:</b>	<b>Physics Laboratory</b>
<b>Subject code</b>	<b>:</b>	<b>M-108</b>
<b>Periods / week</b>	<b>:</b>	<b>03</b>
<b>Total periods / Year</b>	<b>:</b>	<b>45</b>

<b>List of Experiments</b>	<b>No. of Periods</b>
1. Vernier calipers	3
2. Screw gauge	3
3. Parallelogram law of forces and Triangle law of forces (verification)	3
4. Simple pendulum	3
5. Velocity of sound in air (Resonance method)	3
6. Focal length and focal power of convex lens (separate and combination)	3
7. Refractive index of solid using traveling microscope	3
8. Surface tension of liquid using traveling microscope	3
9. Coefficient of viscosity by capillary method	3
10. Boyle's law verification	3
11. Meter bridge	3
12. Mapping of magnetic lines of force	3
Revision	6
Test	3
	-----
Total	45
	-----

## SPECIFIC OBJECTIVES OF PHYSICS LABORATORY

1. **VERNIER CALIPERS** - To determine the volumes of a cylinder and a sphere
2. **SCREW GAUGE** – To determine the thickness of a glass plate and area of cross section of a wire
3. **PARALLELOGRAM LAW AND TRIANGLE LAW VERIFICATION** – To verify laws and determination of unknown weight of an object
4. **SIMPLE PENDULUM** – To determine the value of acceleration due to gravity using law of length and to draw  $l$ - $T$  and  $l$ - $T^2$  curves.
5. **VELOCITY OF SOUND IN AIR** – To determine velocity of sound in air at room temperature and to calculate its value at  $0^\circ\text{C}$  using two tuning forks.
6. **FOCAL LENGTH AND FOCAL POWER OF CONVEX LENSES** – To find focal length and focal power of a single convex lens and combination of convex lenses respectively using  $U$ - $V$  method and draw  $U$ - $V$  and  $1/U - 1/V$  curves for single convex lens experiment only.
7. **REFRACTIVE INDEX OF A SOLID** – To determine the refractive index of material of a glass slab using traveling microscope.
8. **SURFACE TENSION OF A LIQUID** – To determine the surface tension of water using traveling microscope (Capillary method.)
9. **VISCOSITY OF A LIQUID** – To determine viscosity of water by using capillary method
10. **BOYLE'S LAW VERIFICATION** – To experimentally verify Boyle's law employing a Quill tube.
11. **METER BRIDGE** – To find specific resistance of the material of a wire
12. **MAPPING OF MAGNETIC LINES OF FORCE** – To locate the positions of neutral points using N-S and N-N method with the help of magnetic compass

## CHEMISTRY LABORATORY

<b>Subject Title</b>	:	<b>Chemistry Laboratory</b>
<b>Subject Code</b>	:	<b>M- 109</b>
<b>No of periods</b>	:	<b>03</b>
<b>Total periods</b>	:	<b>45</b>

### List of Experiments

1. Introduction to volumetric analysis
2. Preparation of Standard  $\text{Na}_2\text{CO}_3$  solution
3. Estimation of HCl solution using Std.  $\text{Na}_2\text{CO}_3$  solution
4. Estimation of NaOH using Std. HCl solution
5. Estimation of Mohr's Salt using Std.  $\text{KMnO}_4$  solution
6. Determination of acidity of water sample
7. Determination of alkalinity of water sample
8. Determination of total hardness of water using Std. EDTA solution
9. Estimation of Chlorides present in water sample
10. Estimation of Dissolved Oxygen (D.O) in water sample

### **DEMONSTRATION EXPERIMENTS**

11. Determination of pH using pH meter
12. Determination of conductivity of water
13. Determination of turbidity of water
14. High volume air sampler
15. Estimation of total solids present in water sample  
Revision



## **INFORMATION TECHNOLOGY LAB**

<b>Subject Title</b>	<b>:</b>	<b>Information Technology Lab</b>
<b>Subject Code</b>	<b>:</b>	<b>M-110</b>
<b>Periods/Week</b>	<b>:</b>	<b>04</b>
<b>Periods per Semester</b>	<b>:</b>	<b>120</b>

### **SPECIFIC OBJECTIVES**

On completion of this subject the student would be able to

- Identify the various components of a Computer system
- Differentiate between hardware and software
- State the functions of each component of a computer a system
- State the configuration of a computer system
- Identify the various peripherals
- Know how to open an application program
- Know how to create a folder in a specified location
- Open MS-word and Identify the components on the screen
- Create a document using MS-word and save it
- Create a table using MS-Word and save it
- Create mailing letters using mail merge tool of MS-word
- Open MS-Excel and identify the components on the screen
- Create a Worksheet in MS-Excel and save it
- Generate a Chart using the data in Excel-worksheet
- Automate calculations in a worksheet using formula
- Sort and filter data in a worksheet
- Create a simple Power point presentation for a small topic
- Backup required files and folders to a CD-ROM
- Introduction to the internet technology and imparting training to use searching of required sites and using e-Mails etc..

### **COURSE CONTENT:**

1. Study of a computer system
2. Familiarise with basic MS-WINDOWS facilities like opening programs, searching, creating folders, copying and shifting data , etc.
3. Create a formatted word document using MS-Word
4. Familiarise with spell checker facility of MS-Word

5. Print the Word document using page setup and Print facilities
6. Create a soft copy of a given table using MS-Word
7. Create mailing letters for a given information using MS-Word
8. Create a soft copy of the given statistical data using MS-Excel
9. Generate Appropriate Chart for the statistical data using MS-Excel
10. Generate the soft copy of a worksheet using formula facility of MS-Excel
11. Create a soft copy of a simple database using Excel. Run sort and filter facilities for the database
12. Create a power point presentation for a simple technical topic using MS-PowerPoint
13. Create a backup CD for a data using NERO or similar CD writing software
14. Create an user account on the Internet and e-mail and sending a document to from a given e-mail address to another e-Mail ID as attachment.
15. Using different search engines finding required sites to collect information on engineering related topics including down loading the contents.

### **III SEMESTER**

**ENGLISH-II**

**Subject Title** : **English-II**  
**Subject Code** : **M-301**  
**Periods/Week** : **03**  
**Periods per semester** : **45**

**TIME SCHEDULE**


**ENGINEERING MATHEMATICS – II**  
( Common to AEI/C/M/EE/EC/MIN/PKG)

**Subject title** : Engineering Mathematics -II  
**Subject code** : M-302  
**Periods per week** : 04  
**Periods / Semester** : 60

**TIME SCHEDULE**

S.No.	Major Topics	Periods	Weightage of Marks	Short Type	Essay Type
1	<b>Unit –I</b> Integration Methods of Integration	18	35	5	2
2	<b>Unit-II</b> Definite Integrals and Applications	14	26	2	2
3	Numerical Integration	03	05	-	½
4	<b>Unit-III</b> Differential Equations	25	44	3	3½
	<b>Total</b>	<b>60</b>	<b>110</b>	<b>10</b>	<b>8</b>

**Objectives:**

On completion of the study of the subject the student should be able to comprehend the following

**Unit-I**

**Methods of Integration:**

**1.0 Understand the concept of Indefinite integral:**

1.1 Explain that  $\frac{d}{dx}(f(x)) = F(x) \Rightarrow \int F(x)dx = f(x) + c$ , where c is arbitrary constant.

1.2.State the indefinite integral of standard functions and properties of Integrals with examples.

1.3. Integrate simple functions using the rule for  $\int (u + v) dx$  and  $\int ku dx$  where k is constant and u, v are functions of x.

1.4. Evaluate arbitrary constant and determine particular integrals in problems of the following type:

a. Find the equation of the curve passing through (1, 1) and whose slope at any point (x, y) is  $2x^2 + 1/\sqrt{x}$ .

ii) If the velocity at time 't' is given by

$$V = \sqrt{t} + 3 \text{ find the displacement "S" at time } t = k \text{ given that } S = 0 \text{ when } t = 0.$$

1.5. Explain various methods of integration with examples.

1.6. Integrate simple functions by decomposition of the integrand

1.7 Integrate simple functions of the following type by substitution.

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

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

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

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

1.8. Explain finding the Integrals of  $\tan x$ ,  $\cot x$ ,  $\sec x$  and  $\operatorname{cosec} x$  using the above.

1.9. Evaluate the integrals of the form  $\int \sin^m \theta \cos^n \theta. d\theta$  where m and n are

positive integers.

1.10. Evaluate Integrals of powers of  $\tan x$  and  $\sec x$ .

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

1.12 Evaluate the Standard Integrals of the functions of the type

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

1.13. Evaluate the Integrals of the

type  $\int \frac{1}{a \pm b \sin \theta} d\theta, \int \frac{1}{a \pm b \cos \theta} d\theta$  and  $\int \frac{1}{a \cos \theta \pm b \sin \theta \pm c} d\theta$ .

1.14. Evaluate integrals using integration by parts with examples State the Bernoulli's rule for evaluating the integrals of the form  $\int u.v dx$ .

## Unit-II

### 2.0 Definite Integrals and its applications

2.1 Understand the concept of definite integrals and define the definite integral over an interval.

2.2 State various properties of definite integrals.

2.3 Evaluate some problems on definite integrals using the above properties.

2.4. Identify a definite integral as a limit of sum by considering an area.

2.5. State the fundamental theorem of integral calculus.

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

2.7 Obtain the volumes of solids of revolution.

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

### 3. 0 Numerical Integration

3.1 Explain the Trapezoidal rule, Simpson's 1/3 rules for approximation of Integrals and provide some examples.

## Unit –III

### 4.0 Differential Equations

4.1. Definition of a Differential equation – order, degree and solution of a differential equation – formation of differential equations - solutions of ordinary differential equations of the first order and first degree of the type:

i. Variables Separable.

ii Homogeneous Equations.

iii. Exact Differential Equations

iv. Linear differential equation of the form  $dy/dx + Py = Q$ , where P and Q are functions of x or constants.

v. Bernoulli's Equation (Reducible to linear form.)

4.2 Solution of second order differential equation of the type  $f(D)y=0$

4.3 Solution of nth order differential equation of the type

$f(D) y = X$  where  $f(D)$  is a polynomial of nth order and X is a function of the form  $k, e^{ax}, \sin ax, \cos ax, x^n$ .

## COURSE CONTENTS

### Unit-I

#### 1. Methods of Integration.

1. Integration regarded as reverse of differentiation – Indefinite integral and constant of integration – standard forms. Integration by decomposition of the integrand into simple rational, algebraic functions-Integration by substitution or change of variable. Integrals of the form  $\sin^m \theta$ ,  $\cos^n \theta$ , where  $m$  and  $n$  are positive integers. Integrals of  $\tan x$ ,  $\cot x$ ,  $\sec x$ ,  $\operatorname{cosec} x$  and powers of  $\tan x$ ,  $\sec x$  by substitution.

Integrals of:

$$\begin{aligned} i) & \frac{1}{a^2 + x^2}, \frac{1}{a^2 - x^2}, \frac{1}{x^2 - a^2} \\ ii) & \frac{1}{\sqrt{a^2 + x^2}}, \frac{1}{\sqrt{a^2 - x^2}}, \frac{1}{\sqrt{x^2 - a^2}} \\ iii) & \sqrt{x^2 - a^2}, \sqrt{x^2 + a^2}, \sqrt{a^2 - x^2} \end{aligned}$$

Integration by parts including Bernoulli's rule.

### Unit-II

#### 2. Definite Integral and its applications:

Definite integral – 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. Volumes of solids of revolution. Mean value and RMS value of a function in a given interval.

#### 3. Numerical Integration:

Trapezoidal rule, Simpson's 1/3 rules for approximation of Integrals.

### Unit -III

#### 4. Differential Equations:

Definition of a differential equation-order and degree of a differential equation- formation of differential equations-solution of differential equation of the type first order, first degree, variable-separable, homogeneous, exact, linear differential equation of the form  $dy/dx + Py = Q$ , Bernoulli's equation,  $n$ th order linear differential equation with constant coefficients both homogeneous and non homogeneous and finding the Particular Integrals for the functions  $k$ ,  $e^{ax}$ ,  $\sin ax$ ,  $\cos ax$ ,  $x^n$ .

#### Reference books:

- 1 Text book of Engineering Mathematics –II by G.Srinagesh, and others – FALCON publishers
- 2 Text book of Engineering Mathematics –II by Dr.J.Sairam and others – UNI-TECH SERIES.
- 3 A Text book of intermediate Mathematics –I & II by Telugu Academy.
- 4 Integral Calculus by Manicavachagom Pillai
- 5 Text book of Engineering Mathematics –II by Radiant publishers.

## ENGINEERING MECHANICS

<b>Subject Title</b>	:	<b>Engineering Mechanics</b>
<b>Subject Code</b>	:	<b>M-303</b>
<b>Periods/Week</b>	:	<b>05</b>
<b>Periods per year</b>	:	<b>75</b>

### TIME SCHEDULE

<b>S No.</b>	<b>Major Topics</b>	<b>No. of Periods</b>	<b>Weightage of marks</b>	<b>Short Answer Questions</b>	<b>Essay Type Questions</b>
1	Statics & Dynamics	20	34	03	2 ½
2	Friction	15	26	02	2
3	Simple machines	14	21	02	1 ½
4	Geometrical properties of Sections	16	21	02	1 ½
5	Basic Link Mechanism	10	8	01	½
	<b>Total</b>	<b>75</b>	<b>110</b>	<b>10</b>	<b>08</b>

## OBJECTIVES

**On the completion of the course the student should be able to**

### **1.0 Statics & Dynamics**

- 1.1 Explain the meaning of mechanics in engineering.
- 1.2 Understand the importance of mechanics in engineering.
- 1.3 Review the system of units used.
- 1.4 List the types of forces, state their classifications.
- 1.5 State the term equilibrium
- 1.6 Explain the parallelogram law of forces, triangle law of forces, polygon law of forces and Lami's theorem.
- 1.7 Solve the resultant of given system of forces by analytical method.
- 1.8 State the term couple and moment of a couple.
- 1.9 State the condition of equilibrium of a body acted upon by co-planar forces.
- 1.10 Explain linear motion
- 1.11 Define velocity and acceleration.
- 1.12 State Newton's law of motion.
- 1.13 Define inertia, force, momentum, law of conservation of momentum and state the units.
- 1.14 Identify circular motion.
- 1.15 Differentiate Centripetal and Centrifugal forces.
- 1.16 Describe simple harmonic motion.
- 1.17 Appraise the application of simple harmonic motion in engineering.

### **2.0 Friction**



- 2.1 Identify the machine members in which friction exists / desirable
- 2.2 Resolve the forces acting on bodies in motion.
- 2.3 Resolve the forces acting on bodies moving along the plane.
- 2.4 Find the effort required in screw jack

### **3.0 Comprehend the Principles involved in Simple Mechanisms**

- 3.1 Illustrate the use of simple lever of three classes.
- 3.2 Define the terms Mechanical Advantage, Velocity Ratio and Efficiency.
- 3.3 Show that an inclined plane is a simple device to reduce the effort in lifting loads.
- 3.4 Derive expression for VR in cases of wheel & axle, Weston Differential pulley blocks, pulleys, Worm & Worm wheel crabs, simple jack, rack & pinion.
- 3.5 Compute efficiency of a given machine.
- 3.6 Compute effort required to load under given conditions..
- 3.7 Interpret the law of machine.
- 3.8 State the conditions for self-locking and reversibility.
- 3.9 Calculate effort lost in friction and load equivalent of friction.
- 3.10 Evaluate the conditions for maximum M.A.& Maximum efficiency.

### **4.0 Understand the Geometric Properties of Sections**

- 4.1 State the Geometric properties of machine members.
- 4.2 Locate the C.G. of a given composite section.
- 4.3 Explain the meaning of the term moment of Intertia.
- 4.4 State and prove the perpendicular and parallel axis theorem.
- 4.5 Calculate the moment of Intertia of any composite section.
- 4.6 Explain the term Radius of gyration.

### **5.0 Basic Link mechanism**

- 5.1 Define terms like link, kinematics pair, kinematic chain, Mechanism & machine
- 5.2 Give examples for Lower/Higher pairs.
- 5.3 To give examples of inversion.

## ***COURSE CONTENT***

### **1.0 Statics & Dynamics**

- 1.1 The meaning of word mechanics.
- 1.2 Application of Mechanics to Engineering.
- 1.3 System of Units.
- 1.4 System of forces
- 1.5 Equilibrium and Equilibrant.
- 1.6 Statement of Parallelogram law of forces, triangle law of forces, polygon law of forces and lami's theorem
- 1.7 Calculation of resultant by analytical method
- 1.8 Couples and moment of a couple
- 1.9 Condition for equilibrium of a rigid body subjected to number of coplanar forces.
- 1.10 Introduction
- 1.11 Scalar and Vector Quantities
- 1.12 Newton's law of motion

- 1.13 Inertia, force, momentum, law of conservation of momentum, work, power and energy-definition, expression, units and law of conservation of energy and problems.
- 1.14 Circular motion, angular displacement, velocity and acceleration
- 1.15 Centripetal and Centrifugal forces, units and practical application.
- 1.16 Simple Harmonic motion – Description, formula for velocity and acceleration (No proof)
- 1.17 Application of Simple Harmonic Motion.

## 2.0 Friction

- 2.1 Resolution of Forces considering Friction when a body moves on an horizontal plane.
- 2.2 Resolution of Forces considering Friction when a body moves on an inclined plane.
- 2.3 Applications: Screw jack.
- 2.4 Numerical examples to calculate effort.

## 3.0 Simple Machines

- 3.1 Definition of Simple machine, and uses of simple machine, levers and inclined plane.
- 3.2 Fundamental terms like mechanical advantage, velocity ratio and efficiency.
- 3.3 Expressions for VR in case of Simple/Differential pulley/pulleys of 3 systems, Worms and Worm wheel, Rack and pinion, Winch crabs, & Simple screw jack.
- 3.4 Conditions for reversibility and self locking.
- 3.5 Law of Simple Machine.
- 3.6 Effort lost in friction, Load Equivalent of Friction Max. M.A. and Max. efficiency.

## 4.0 Geometric Properties of Sections

- 4.1 a) Definition and explanation of centre of gravity of a lamina area.
  - b) Centre of Gravity of a body.
  - c) Centre Gravity of a square, rectangle, triangle, Semi-circle, hemisphere and trapezium (formulae only without derivations)
- 4.2 Centre of gravity of a composite section by analytical method only (I-section, T-Section, L-Section and channel section).
- 4.3 Moment of Inertia.
  - a) Definition and Explanation.
  - b) Theorems of Moment of Inertia.
    - i) Parallel axes theorem.
    - ii) Perpendicular axes theorem.
  - c) Moment of Inertia for simple Geometrical Sections – Rectangular, circular and triangular section only.
  - d) Radius of Gyration.
- 4.4 Calculation of Moment of Inertia and Radius of Gyration of
  - a) I – Section.
  - b) Channel Section.
  - c) T – Section.
  - d) L – Section (Equal & unequal lengths)

e) Built up Sections (Simple cases only)

## **5.0 Basic Link Mechanism**

- 5.1 Definitions of terms: Link, Kinematic pair, kinematic Chain, mechanism, Structure and machine.
- 5.2 Quadric cycle chain and its inversions.
- 5.3 Slider Crank chain and its inversion.
- 5.4 Straight Line Mechanism.

## **REFERENCE BOOKS**

- 1. Engineering Mechanics by R.S.Khurmi.
- 2. Engineering Mechanics by I.B.Prasad
- 3. Engineering Mechanics by Singer.
- 4. Engineering Mechanics by M. Srinivasulu

## ELECTRICAL ENGG. & BASIC ELECTRONICS

**Subject Title** : Electrical Engg. & Basic Electronics  
**Subject Code** : M-304  
**Periods/Week** : 05  
**Periods per semester** : 75

### TIME SCHEDULE

S. No	Major Topics	No. of Periods	Weightage of Marks	Short Answer Questions	Essay Type Questions
1.	Basic Concepts & Electro magnetic Induction	15	24	03	1 ½
2.	D.C. Machines	15	21	02	1 ½
3.	A.C. Fundamentals & A.C. Machines	24	31	02	2 ½
4.	Storage Batteries	05	08	01	½
5.	Semi Conductors	08	13	01	01
6.	Electrical measuring instruments & Safety procedures	08	13	01	01
<b>Total</b>		<b>75</b>	<b>110</b>	<b>10</b>	<b>08</b>

### OBJECTIVES

*On the completion of course the student should be able to*

#### 1.0 Comprehend Basic Electrical Fundamentals.

- 1.1 Define Ohm's Law.
- 1.2 State the Laws of Resistance.
- 1.3 State work, power and energy, with units.
- 1.4 State and explain Kirchoff 's laws.
- 1.5 Define
  - a. Magnetic field strength
  - b. Flux
  - c. Permeability
  - d. Reluctance
- 1.6 Define
  - a. Electric field
  - b. Electric field intensity
  - c. Permittivity
- 1.7 State capacitance.
- 1.8 State Faradays laws of Electro Magnetic Induction.
- 1.9 Explain dynamically and statistically Induced E.M.F.
- 1.10 State Lenz's Law.
- 1.11 Explain Fleming's right hand rule.
- 1.12 Solve problems on the above.
- 1.13 Explain inductance
  - a. Self inductance
  - b. Mutual inductance

- c. Coefficient of coupling
- 1.14 Solve problems on self and mutual Inductances.
- 1.15 Explain energy stored in a magnetic field.
- 1.16 Lifting power of a magnet.

## **2.0 Understand D.C. Machines.**

- 2.1 Explain working principle of D.C. Generator.
- 2.2 Constructional features of D.C. Generator and materials used.
- 2.3 (a) List out type of D.C. Generators.  
(b) Draw schematic diagram of each type.
- 2.4 (a) Write formula for E.M.F equation of a D.C. Generator [no derivation]  
(b) State the relation between currents and voltages for different types of D.C generators.
- 2.5 Label the terminals of a D.C. Generator for armature, field and inter pole windings.
- 2.6 Simple problems on the above.
- 2.7 Draw power flow diagram of D.C. Generator.
- 2.8 Sketch the connection of welding generator
- 2.9 Explain the principle of operation of D.C. Motor.
- 2.10 (a) List out types of motors.  
(b) Draw Schematic diagram of each type.
- 2.11 (a) Explain back e.m.f.  
(b) State the relation between currents and voltages.
- 2.12 Write formula for speed of D.C. Motor in terms of supply voltage, current and flux.
- 2.13 Explain torque.
- 2.14 Write torque equation [No derivation]
- 2.15 Solve simple problem on above.
- 2.16 Explain necessity of starters.
- 2.17 Describe with sketch the connection diagram of D.C. 3 point starter.
- 2.18 Explain speed control of D.C. Motors.  
a. Field control b. Armature control
- 2.19 State applications.

## **3.0 Understand A.C. Fundamentals and A.C. Machines**

- 3.1 Explain
  - i) Alternating current
  - ii) Amplitude (Peak Value)
  - iii) Time Period
  - iv) Frequency
  - v) Instantaneous value
  - vi) Average value
  - vii) R.M.S Value
  - viii) Form Factor
- 3.2 Explain graphical and vector representation of alternating quantities.
- 3.3 Explain phase, phase difference.
- 3.4 State power in an A.C. circuit and power factor [No derivation]
  - i) Pure resistance
  - ii) Pure inductance
  - iii) Capacitance
- 3.5 Explain single phase circuit
  - a) Simple series circuit consisting R-L, R-C, and R-L-C.

- 3.6 Calculate the impedance, current, PF, Power and Voltage drops in a given (R-L-C) circuit.
- 3.7 Solve simple problems on series circuits.
- 3.8 Explain poly phase and 3 phase system.
- 3.9 Explain phase difference in 3 phase system.
- 3.10 State Star-Delta connection.
- 3.11 Explain working principle of alternator.
- 3.12 Explain constructional features of Alternators.
- 3.13 State frequency and speed relations.
- 3.14 Explain working principle of transformer and rating of transformer.
- 3.15 Write relation between turns ratio, Voltage ratio and current ratios
- 3.16 Describe with sketch a welding Transformer.
- 3.17 Explain three phase induction motor working Principle.
- 3.18 Explain constructional features of – 3 phase Induction motors.
  - a. Squirrel cage induction motor.
  - b. Wound rotor induction motor.
- 3.19 Describe with sketch
  - a. D.O.L Starter
  - b. Star – Delta Starter
- 3.20 Explain forward and reverse running of Induction motor.
- 3.21 State the application of 3 phase induction Motor.
- 3.22 Explain the working principle of single Phase induction motor.
- 3.23 List out types of single phase induction Motors.
- 3.24 Sketch circuit diagram for single phase Induction motors.
- 3.25 Explain forward and reverse running of Single phase induction Motor
- 3.26 Applications of single phase induction Motors.

#### **4.0 Understand Storage Batteries.**

- 4.1 Explain difference between primary and secondary cells.
- 4.2 State types of storage cells.
- 4.3 Explain lead acid cell.
- 4.4 Explain chemical reactions during charge and discharge.
- 4.5 Explain the charging methods of batteries
  - a. Constant current method.
  - b. Constant Voltage method.
- 4.6 State indications of full charging.
- 4.7 Explain capacity of a battery
- 4.8 Explain Nickel iron and Nickel cadmium Cells.
- 4.9 Compare lead acid and Ni -Fe cells
- 4.10 Care and maintenance of lead acid cells.

#### **5.0 Understand the Principles of Semi-Conductor Devices.**

- 5.1 Classify materials as conductor, semi-conductors and insulators.
- 5.2 Distinguish between intrinsic and extrinsic semiconductors.
- 5.3 Describe the formation of P type and N type materials.
- 5.4 Identify majority and minority carries in P&N type materials.
- 5.5 Explain the formation of PN Junction diode.
- 5.6 Describe the working of PN junction diodes with forward bias & reverse bias.
- 5.7 Understand the working of PNP & NPN transistors
- 5.8 Draw the different transistor configuration.

- 5.9 Sketch the input & output characteristics of C.B., C.E & C.C. Configuration.
- 5.10 Describe the operation of Zener diode.
- 5.11 Distinguish between Zener & Avalanche break – down.
- 5.12 Explain the operation of LED, LCD & the materials used.

## **6.0 Understand Electrical Measuring Instruments and Safety Procedures.**

- 6.1 Explain construction and working principle of moving Coil ammeter and volt meter.
- 6.2 Explain construction and working principle of moving iron ammeter and voltmeter.
- 6.3 Explain construction-working principle of dynamometer type wattmeter.
- 6.4 Explain construction and working principle of A.C. single phase induction type energy meters.
- 6.5 Sketch connection diagram of single phase energy meter with load.
- 6.6 Explain effect of electrical shock and burn.
- 6.7 State procedure to be adopted in case of electric shocks.
- 6.8 State purpose of earthing of electrical equipment and machinery.
- 6.9 Describe the procedure for pipe earthing.

## **COURSE CONTENTS**

### **1.0 Basic Concepts and Electro Magnetic Induction**

- 1.1 Definitions: Ohm' Law, Laws of resistance work, power, energy with units.
- 1.2 Kirchoff's Laws
- 1.3 Definitions and units magnetic field strength, flux, flux density, permeability, reluctance.
- 1.4 Definitions and units electric field, field strength, permittivity, capacitance.
- 1.5 Faraday's laws of Electro – magnetic induction.
- 1.6 Dynamically and statically induced e.m.f.
- 1.7 Lenz's Law, Fleming's right hand rule.
- 1.8 Problems on above.
- 1.9 Inductance – self and mutual – coefficient of coupling.
- 1.10 Simple problems
- 1.11 Energy stored in a magnetic field.
- 1.12 Lifting power of magnet.

### **2.0 D.C. Machines**

#### **2.1 D.C. Generators**

- a) Principle of operation.
- b) Parts of generator and materials use.
- c) Types of generators and schematic diagrams.
- d) E.M.F equation (No derivation) and voltage current relations.
- e) Nomenclature used for determining armature, field and interpole windings etc.
- f) Solve simple problems on the above.
- g) Power flow diagram.
- h) Welding Generator.

#### **2.2 D.C. Motors**

- a) Principle of operation.

- b) Types of motors and schematic diagrams
- c) Back e.m.f and speed equation and relation between voltages and currents.
- d) Torque and Torque equation
- e) Starters necessity and connection diagram of 3 point starter.
- f) Speed control – field and armature control.
- g) Applications of motors.

### **3.0 A.C. Fundamentals and Machines**

- 3.1 Definition – alternating current, voltage amplitude, time period frequency, instantaneous value, Average value, r.m.s. value, form factor.
- 3.2 Graphical and vector representation of Alternating quantities.
- 3.3 Phase difference.
- 3.4 Power in A.C. Circuits and power factor (No Derivation).
- 3.5 Nature of current when alternating voltage is applied to pure resistance, inductance and capacitance – magnitude of current, power factor, power factor angle and power.
- 3.6 A.C. Circuits.
- 3.7 Single phase series circuits – calculation of impedance, current, power factor, power and voltage drops.
- 3.8 3 – phase circuits
  - a) Definition of poly – phase and 3 phase circuits.
  - b) Phase difference in 3 phase system.
  - c) Star and delta connections, definitions of phase values and line values.
- 3.9 Alternators – principle of working.
- 3.10 Constructional features of alternators.
- 3.11 Speed and frequency relations.
- 3.12 Transformers working principle.
- 3.13 Single phase transformers.
  - a) Voltage ratio b) Current ratio
  - c) Turns ration.
- 3.14 Welding transformer.
- 3.15 Phase Induction Motor
  - a) Working principle of induction motor.
  - b) Construction of induction motor
    - i) Squirrel cage induction.
    - ii) Wound Rotor induction motor.
  - c) Starters.
    - i) D.O.L.
    - ii) Star/Delta starter.
  - d) Forward and reverse running of Induction motors.
- 3.16 Single phase induction motors.
  - a) Types of single phase induction motors.
  - b) Circuit diagram of each type of single Phase induction motor.
  - c) Forward and reverse running of single Phase induction motors.
  - d) Applications of single phase induction Motors.



#### 4.0 Storage Batteries.

- a) Difference between primary and Secondary cells
- b) Types of storage cell
- c)
  - i) lead Acid cell
  - (ii) Iron cell.
- d) Theory of lead acid cell.
- e) Chemical reactions during charging and discharging.
- f) Charging batteries:-
  - i) Constant current method
  - ii) Constant voltage method.
- g) Indications of full charging.
- h) Capacity of battery and factors effecting the capacity
- i) Theory of Nickel – iron, Nickel – Cadmium Cell.
- j) Comparison of lead acid and Ni-Fe cells.
- k) Uses.
- l) Care and maintenance of lead acid cells.

#### 5.0 Semi – Conductors.

- 5.1 Semi – conductors – N-Type, P-type.
- 5.2 Behaviour of PN Junction diode
- 5.3 Introduction of PNP, NPN Transistors.
- 5.4 Transistor configuration – Zener diodes.
- 5.5 LED, LCD, Seven segment display.

#### 6.0 Electrical Measuring Instruments & Safety Procedures

- 6.1 Construction and principle of operation of moving coil permanent magnet type ammeter and voltmeter and moving iron ammeter and voltmeter.
- 6.2 Construction and working principle of
  - a) Dynamometer and wattmeter.
  - b) A. C. Single phase induction type Energy meter.
  - c) Connection diagram of single phase energy meters with load.
- 6.3 Safety Procedures.
  - a) Effects of shock and burns.
  - b) Procedures to be adopted in case of electrical shocks.
  - c) Earthing of electrical equipment and machine

#### REFERENCE BOOKS

1. Theraja B.L. - A Text Book of Electrical Engg. and Electronics.
2. Mehtha.V.K - Principles of Electronics
3. Gupta - Fundamentals of Elec. Engg.
4. Uppal - A Text Book of Elec.Engg & Electronics.
5. Bharadwajan - Electrical Engineering.
6. Prabhakar Rao - Fundamentals of Electronics

## THERMAL ENGINEERING-I

**Subject Title** : Thermal Engineering-I  
**Subject Code** : M-305  
**Periods/Week** : 05  
**Periods per Semester** : 75

### TIME SCHEDULE

S. No.	Major Topics	Periods	Weightage of Marks	Short Answer Questions	Essay Type Questions
1	Fundamental of thermodynamics	09	13	1	1
2	Laws of perfect gases	04	08	1	1/2
3	Thermodynamic processes in gases	18	26	2	2
4	Fuels and combustion	10	16	2	1
5	Air Standard Cycles	12	18	1	1 1/2
6	Properties of Steam	12	16	2	1
7	Fundamentals of Refrigeration and air conditioning	10	13	1	1
	<b>Total</b>	<b>75</b>	<b>110</b>	<b>10</b>	<b>08</b>

**OBJECTIVES:** *On the completion of the course the student will be able to*

**1.0 Understand the Fundamentals and laws of Thermodynamics.**

- 1.1 Define the various terms associated with the Thermodynamic System.
- 1.2 Define the 'State and System'.
- 1.3 Name the types of thermodynamic Systems.
- 1.4 Explain the closed system with Examples.
- 1.5 Explain the open system with examples
- 1.6 Explain the isolated system with Examples.
- 1.7 List the thermodynamic Properties of System.
- 1.8 Define the various thermodynamic properties.
- 1.9 Write examples for each type of property and its units of measurement.
- 1.10 State the number of properties required to define the state of a system.
- 1.11 Define the modes of energy transfers to and from a system.
- 1.12 Represent the state of a system on a Graph.
- 1.13 State the Zeroth law of thermodynamics.
- 1.14 State the first law of thermodynamics.
- 1.15 State the second law of thermodynamics.
- 1.16 Solve problems dealing with conversion of heat into work and vice – versa.
- 1.17 Write steady flow energy equation.
- 1.18 Write non-flow energy equation.
- 1.19 Solve simple problems on energy equation.

**2.0 Understand the laws of perfect gases.**

- 2.1 Define the term 'Perfect Gas'.
- 2.2 State "Boyle's Law".
- 2.3 State "Charle's Law".

- 2.4 State "Avagadro's Law".
- 2.5 State "Regnault's Law".
- 2.6 State "Joule's Law".
- 2.7 Derive Characteristic gas equation.
- 2.8 Write the Universal Gas Equation.
- 2.9 State relationship between characteristic gas constant (R), Universal gas constant (G) and molecular weight (M).
- 2.10 Define "Specific heat at constant pressure" ( $C_p$ ).
- 2.11 Define "Specific heat at constant volume ( $C_v$ )".
- 2.12 Infer why  $C_p$  is more than  $C_v$ ?
- 2.13 Derive the relationship connecting the two specific heats and Characteristic gas constant (R).
- 2.14 Solve simple problems using gas laws.

### **3.0 Understand Thermodynamic Processes on gases.**

- 3.1 List out the different thermodynamic processes on gases.
- 3.2 Derive expression for work done in Iso-choric process.
- 3.3 Derive expression for work done in Iso-baric process.
- 3.4 Derive expression for work done in hyperbolic process.
- 3.5 Infer that Isothermal process is the same as hyperbolic process for gases.
- 3.6 Derive expression for work done in a polytropic process.
- 3.7 Derive expression for work done in a Isentropic process.
- 3.8 Justify that work done in throttling process is Zero.
- 3.9 Explain the concept of Entropy.
- 3.10 Derive the expression for change of Entropy for the above processes.
- 3.11 Compute the change in internal energy of gas during a process.
- 3.12 Write the relationship between heat supplied, internal energy and work done.
- 3.13 Sketch pressure- volume and temperature - Entropy diagram for the above processes.
- 3.14 Solve simple problems on the processes.

### **4.0 Know the fuels and combustion.**

- 4.1 Define the term fuel.
- 4.2 Name different types of fuels with examples.
- 4.3 Outline the applications of different fuels.
- 4.4 Define "Higher Calorific Value" of a fuel.
- 4.5 Define "Lower Calorific Value" of a fuel.
- 4.6 Re-write Dulong's formula for calorific value from chemical composition of a fuel.
- 4.7 Estimate the calorific value using the above formula.
- 4.8 Compare solid, liquid and gaseous fuels.
- 4.9 Explain with line diagram the components of a Bomb-Calorimeter.
- 4.10 Narrate the sequence of procedure for the determination of calorific value using Bomb calorimeter.
- 4.11 Explain the working principle of Junker's Gas Calorimeter with a line diagram.
- 4.12 Narrate the sequence of procedure in the determination of C.V. of a gaseous fuel with Junker's Calorimeter.
- 4.13 Write the balance of chemical equation for the composition of Unit mass/unit volume of a given fuel.

- 4.14 Estimate the minimum air required for complete combustion of unit mass / unit volume of a fuel of given composition.
- 4.15 Estimate the percentage composition of flue gases during combustion with or without excess air.

## **5.0 Appreciate the study of air standard cycles.**

- 5.1 Define the term 'Air Standard cycle'
- 5.2 Define the term 'Reversible Cycle'.
- 5.3 Explain with a line diagram the Working of Carnot cycle.
- 5.4 State the assumptions made in Carnot cycle.
- 5.5 Derive the formula for the air standard efficiency of a Carnot cycle.
- 5.6 Solve simple problems on Carnot Cycle.
- 5.7 Explain the working of Otto Cycle with help of a line diagram.
- 5.8 State the assumptions made in Otto Cycle.
- 5.9 Derive the formula for air standard Efficiency of Otto Cycle.
- 5.10 Solve simple problems on Otto Cycle.
- 5.11 Explain the working of a Diesel cycle with line diagrams.
- 5.12 State assumptions made in Diesel Cycle.
- 5.13 Derive the formula for Air Standard Efficiency of Diesel Cycle.
- 5.14 Solve the simple problems on Diesel Cycles.
- 5.15 State the reasons for Carnot cycle being highly efficient than any other cycle working between the same temperature limits.

## **6.0 Understand the Properties of Steam**

- 6.1 Define the various properties of steam
- 6.2 Compute the enthalpy, internal energy and entropy at given pressure.
- 6.3 Use of the steam tables
- 6.4 Interpret the data in steam tables to calculate enthalpy and entropy.
- 6.5 Compute the above values using Mollier chart.
- 6.6 Solve simple problems on the above.
- 6.7 Identify the various thermodynamic processes (Expansion & Compression of vapours)
- 6.8 Compute the work done, internal energy, enthalpy and entropy in each of the above processes.
- 6.9 Represent the above process on T-S and H-S diagrams

## **7.0 Understand the various methods of Refrigeration.**

- 7.1 Define refrigeration.
- 7.2 Know the history of refrigeration.
- 7.3 Know principles involved in different methods of refrigeration such as ice, dry ice, steam jet water refrigeration, liquid nitrogen refrigeration.
- 7.4 Express unit of refrigeration in Terms of ton of refrigeration.
- 7.5 Define coefficient of Performance.  
Evaluate power required per ton of refrigeration.
- 7.7 Know the principle of open air refrigeration.
- 7.8 Analyse Carnot refrigeration Cycle.
- 7.9 Analyse Bell-Columen air-cycle.
- 7.10 Know principle of closed air Refrigeration.
- 7.11 Compare open air system with closed air system.

## **COURSE CONTENTS**

### **1.0 Fundamentals and laws of Thermodynamics.**

- 1.1 Definitions for system - boundary, surrounding, working fluid and state of a system.
- 1.2 Types of thermodynamic systems – closed, open and isolated systems with examples.
- 1.3 Properties of a system- Intrinsic and Extrinsic properties with examples.
- 1.4 Definitions for properties like pressure ( $p$ ), Volume ( $v$ ), Temperature ( $T$ ), Enthalpy ( $H$ ), Internal energy ( $U$ ) and their units.
- 1.5 Definitions for quasi-static work, flow- work, specific heat.
- 1.6 Zeroth, first, second laws of thermodynamics, simple problems on conversion of Heat into Work and vice versa.
- 1.7 Steady flow energy equation (without proof), simple problems of elementary type.

### **2.0 Laws of perfect gases.**

- 2.1 Brief explanation of perfect Gas Laws – Boyle's law, Charle's Law – Avagadro's Joule's law and Regnault's law.
- 2.2 Derive characteristic gas equation - universal gas equation, universal gas constant and their relationship with molecular weight of gas.
- 2.3 Specific heat at constant pressure, specific heat at constant volume for a gas. Derivation for an expression showing the relationship between the two specific heats and characteristic gas constant.
- 2.4 Simple problems on gas equation.

### **3.0 Thermodynamic processes on gases.**

- 3.1 Types of thermodynamic processes, Isochoric, Isobaric, Isothermal, hyperbolic, Isentropic, Polytropic and throttling processes. Equations representing the processes.
- 3.2 Concept of Entropy.
- 3.3 Derivation for work done, change in internal energy and Entropy for the above processes.
- 3.4 Calculation of heat supplied or rejected during the above processes.
- 3.5 Simple problems on the above processes.

### **4.0 Fuels and Combustion.**

- 4.1 Definition of fuel. Types – solid, liquid and gaseous fuels examples and uses of different types of fuels.
- 4.2 Calorific values (Higher and lower) of fuels, Dulong's formula for calorific value. Calculation of calorific value of a fuel of given chemical composition.
- 4.3 Bomb calorimeter unit-Description-procedure for determination of C.V. of solid or liquid fuel using Bomb calorimeters.
- 4.4 Junker's Gas calorimeters unit – Description – determination of gas using Junker's calorimeter.
- 4.5 Balance chemical equations for the combustion of carbon, Hydrogen, sulphur, Methane, Ethane etc.
- 4.6 Calculation of minimum air required for the complete combustion of unit mass/unit volume of fuel having a given composition. Conversion of volumetric analysis to gravimetric analysis, and vice-versa. Calculation of percentage composition (by weight and volume) of flue gases with and without excess air, simple problems.

## **5.0 Air standard cycles.**

- 5.1 Meaning of air standard cycle-its use-Reversible and irreversible process – reversible and irreversible cycles conditions for reversibility of a cycle.
- 5.2 Brief description of Carnot cycle with P.V. and T-S diagrams, Assumption made – Efficiency - Problems on Carnot cycle.
- 5.3 Brief explanation of Otto cycle with P.V. and T-S diagrams, assumptions made – Efficiency - Simple problems on Otto cycle.
- 5.4 Brief description of Diesel cycle with P.V. and T-S diagrams, Assumption made – Efficiency - Simple problems on Diesel cycle.
- 5.5 Reasons for the highest efficiency of Carnot cycle over other cycles working between same temperature limits.

## **6.0 Properties of steam.**

- 6.1 Formation of steam under constant pressure, dryness, fraction and degree of superheat, specific volume.
- 6.2 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.
- 6.3 Simple direct problems on the above using tables and charts.
- 6.4 Vapour processes – simple problems using tables and charts.

## **7.0 Fundamentals of Refrigeration and Air Refrigeration**

Introduction – Definition and meaning of refrigeration, methods of refrigeration – unit of refrigeration – COP.

Thermodynamic analysis of Refrigeration cycles, Carnot refrigeration cycle – Air refrigeration cycle (Bell – Coloman) open air and closed air systems of refrigeration( problems omitted ).

## **REFERENCE BOOKS**

1. Thermal Engg. - Mathur & Mehta
2. Heat Engines R. C. Pate & Karamchandani
3. I. C. Engine Fundamentals - Heywood
4. Engineering Thermodynamics P. K. Nag
5. Engineering Thermodynamics C. P. Arora
6. Thermal Engineering - R. S. Kurmi
7. Thermal Engineering Kumar & Vasundari
8. Automotive Engineering - Kirpal Singh
9. Automobile Engineering - Narang
10. Thermal Engineering – I - M. Srinivasulu

## MANUFACTURING TECHNOLOGY - I

Subject Title	:	Manufacturing Technology - I
Subject Code	:	M – 306
Periods Per Week	:	05
Periods Per Semester	:	75

### TIME SHEDULE

S.No	Major Topics	Number of Periods	Weightage of Marks	Short answer Questions	Essay type Questions
1	Lathe & Lathe Work	22	34	03	2 ½
2	Shaper, Slotter, Planner	14	18	01	1 ½
3	Broaching Machine	04	08	01	½
4	Cutting Fluids, Coolants and Lubricants	06	08	01	½
5	<b>Welding</b>	15	26	02	02
6	Metrology	14	16	02	01
	<b>Total</b>	<b>75</b>	<b>110</b>	<b>10</b>	<b>08</b>

### OBJECTIVES

*On the completion of the course the students should be able to:*

#### 1. 1.0 Lathe & Lathe Work

- 1.1. State the working principle of lathe.
- 1.2. Write classification of lathes.
- 1.3. Draw the line diagrams of engine lathe.
- 1.4. Identify the parts of lathe.
- 1.5. Describe the functions of each part in lathe.
- 1.6. Indicate the specifications of a lathe.
- 1.7. List out the various operations performed on lathe including special operations.
- 1.8. Explain at least four methods of taper turning with line diagrams.
- 1.9. Calculate the included angle for taper turning.
- 1.10. List out different work holding devices.
- 1.11. Nomenclature of Lathe (single point) tool.
- 1.12. Functions of various angles.
- 1.13. Tool signature.
- 1.14. Identify various types of Production lathes.
- 1.15. Illustrate the working principle of turret lathe, Capstan, Automatic and Semi-automatic lathes & copying lathes.
- 1.16. Know the differences between automatic and semi-automatic lathes.
- 1.17. Know the need of copying lathes.
- 1.18. State the advantages and applications of production lathes.

#### 2. Illustrate the working of Shaper, Slotter, Planer.

- 2.1. State the working principles of these machines with line sketches.
- 2.2. Illustrate the constructional details of the machines.
- 2.3. Explain the functions of importance parts of the machines.
- 2.4. List out the operations performed on these machines.
- 2.5. State the specifications of each machine.

- 2.6. Explain the principle of quick-return mechanism as applied to shaper/planer.
- 2.7. Describe the different methods of obtaining quick return motion.
- 2.8. Explain the principle of hydraulic drive with the help of a line diagram applied to shaper.

### **3. Broaching Machine**

- 3.1. Define Broaching.
- 3.2. Illustrate the constructional details of the machines.
- 3.3. Categorise the broaching machines.
- 3.4. Illustrate the working of the broaching.
- 3.5. State the advantages & limitations of broaching

### **4. Cutting Fluids, Coolants & Lubricants.**

- 4.1. State the properties of cutting fluids and coolants.
- 4.2. Mention the types of fluids.
- 4.3. State the composition of cutting fluids and coolants.
- 4.4. Point out the relative merits of the cutting fluids and coolants.
- 4.5. Select the proper cutting fluids and coolants for various machining operations.
- 4.6. Classify the Lubricants.
- 4.7. Identify various properties of Lubricants.

### **5. Understand the different Welding Methods and Techniques.**

- 5.1. State the necessity of welding.
- 5.2. Classify the welding processes.
- 5.3. State the advantages and limitations of welding.
- 5.4. Explain the principle of Arc Welding.
- 5.5. Identify the tools and equipment of Arc Welding.
- 5.6. Choose the proper electrodes for given metals.
- 5.7. Explain the principles of gas welding.
- 5.8. Identify the tools and equipment of oxy-Acetylene Welding.
- 5.9. Explain different welding procedures in Arc and Gas Welding.
- 5.10. Define the terms soldering & brazing.
- 5.11. Differentiate soldering from brazing.
- 5.12. Explain the principles of soldering & brazing.
- 5.13. Select correct soldering materials for a given job.
- 5.14. Explain soldering / brazing techniques.
- 5.15. Identify the gas cutting equipment.
- 5.16. State the principle of flame cutting.
- 5.17. State the relative advantages of flame cutting over other types of cutting.
- 5.18. Identify the various defects in welds.
- 5.19. List the reasons for the above.
- 5.20. Explain non-destructive testing of welds.
- 5.21. List out various (special) modern welding techniques.
- 5.22. State in brief the principle of at least four modern welding techniques.



## **6. Metrology**

- 6.1. Identify various linear and angular measuring instruments.
- 6.2. Explain the principle of working of (at least 4 types) comparators with sketches.
- 6.3. Predict the amount of measuring accuracy using the comparator.
- 6.4. Identify the in-accuracies in surface finish.
- 6.5. Suggest the surface finish measuring instrument.
- 6.6. State the use of collimator and microscope.
- 6.7. State the principle of working of interferometer.

## **COURSE CONTENTS**

### **1.0 Lathe and Lathe Work**

- 1.1 Working Principle of Lathe
- 1.2 Types of Lathe
- 1.3 Engine lathe – construction details – specifications.
- 1.4 Lathe tool terminology
- 1.5 Geometry , Tool signature
- 1.6 Functions of tool angles.
- 1.7 General and special operations – (Turning, facing, taper turning thread cutting knurling, forming drilling, boring, reaming, key way cutting.)
- 1.8 Lathe accessories viz., work holding devices and tool holding devices
- 1.9 Turret lathe: Sketch – Operation – Advantages.
- 1.10 Capstan Lathe: Sketch – Operation – Advantages.
- 1.11 Comparison of Engine (Centre lathe) – Turret – Capstan lathe.
- 1.12 Semi Automatic lathe – Features.
- 1.13 Automatic Lathe – Features.
- 1.14 Copying lathe – applications.

### **2.0 Shaping, Slotting, Planning Machines.**

- 2.1 Introduction.
- 2.2 Construction details and specifications of shaper, slotter and planer.
- 2.3 Operations on these machines.
- 2.4 Tools and materials.
- 2.5 Driving mechanisms: Quick return arrangement: Crank & slotted lever mechanism – Whitworth mechanism – Hydraulic drive.
- 2.6 Introduction.

### **3.0 Broaching Machines**

- 3.1 Types of broaching machines – Horizontal type (Single ram & duplex ram) Vertical type, Pull up, pull down, and push down.
- 3.2 Elements of broach tool, broach teeth details – nomenclature – types – tool material.

### **4.0 Cutting Fluids & Lubricants.**

- 4.1 Introduction.
- 4.2 Types of cutting fluids
- 4.3 Fluids and coolants required in turning, drilling, shaping, sawing & broaching, selection of cutting fluids, methods of application of cutting fluid.

- 4.4 Classification of lubricants ( solid, liquid, gaseous)
- 4.5 Properties and applications of lubricants.

## 5.0 Welding.

- 5.1. Introduction.
- 5.2. Classification of welding processes ( IS 812)
- 5.3. Advantages and limitations of welding.
- 5.4. Principles of Arc Welding.
- 5.5. Arc welding equipment.
- 5.6. Choice of electrodes for different metals.
- 5.7. Principle of gas (Oxy – acetylene) welding.
- 5.8. Equipment of gas welding.
- 5.9. Welding procedures ( Arc & Gas )
- 5.10. Soldering and Brazing techniques.
- 5.11. Types and applications of solders & fluxes.
- 5.12. Various flame cutting processes.
- 5.13. Advantages and limitations of flame cutting.
- 5.14. Defects in welding.
- 5.15. Testing and inspection.
- 5.16. Modern welding methods, (Submerged CO<sub>2</sub> Atomic – Hydrogen, ultrasonic, welding), MIG & TIG Welding.

## 6.0 Metrology.

- 6.1 Linear measurement: Slip gauges and dial indicators.
- 6.2 Angle measurements: Bevel protractor, Sine Bar, Angle Slip Gauges.
- 6.3 Comparators :
  - a) Mechanical    b) Electrical    c) Optical    d) pneumatic
- 6.4 Measurement of surface roughness: methods of measurements by comparison, tracer instruments and by interferometry.
- 6.5 Collimators.
- 6.6 Measuring Microscope. Interferometer

## REFERENCES

- |    |  |    |               |
|----|--|----|---------------|
| 1. | Welding Technology                           | by | Little.       |
| 2. | Elements of Work Shop Technology vol. I & II | by | Hazra Choudry |
| 3. | Engineering Metrology                        | by | Jain          |
| 4. | Welding Technology                           | by | Parmar        |

## MACHINE DRAWING

Subject Title : Machine Drawing  
Subject Code : M-307  
Periods/ Week : 06  
Periods/Semester : 90

### TIME SCHEDULE

S.No	Major Topics	Periods	Weightage of Marks	Short answer Questions	Essay type Questions
1.	Introduction	12	-	-	-
2.	Fastening Devices	18	10	02	-
3.	Assembly Drawings	33	80	-	02
4.	Piping Layouts and Joints	15	05	01	-
5.	Welding Fabrications Drawings	12	05	01	-
	<b>Total</b>	<b>90</b>	<b>100</b>	<b>04</b>	<b>02</b>

**Note:-**

Candidate has to answer all questions in part- A and one question out of two in part- B

### OBJECTIVES

On the completion of the course the student should be able to

#### 1.0 Introduction

- 1.1. Know the importance of Machine drawing.
- 1.2. Review of 1<sup>st</sup> angle and 3<sup>rd</sup> angle Projections
- 1.3. Review of Orthographic Projections and Sectional Views.

#### 2.0 Know about fastening devices.

- 2.1. Drawing the standard thread profile.
- 2.2. Draw/sketch bolted connections to standard of proportions.
- 2.3. Draw/sketch different types of screws.
- 2.4. Draw/sketch different types of rivets and riveted connections.
- 2.5. Draw/sketch different types of keys and cotters.

#### 3.0 Prepare assembly drawing.

- 3.1. List the sequence of steps for preparing assembly drawing.
- 3.2. Prepare the assembly drawing given the components drawing.
- 3.3. Prepare the list of parts.

#### 4.0 Formulate piping layouts.

- 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. Draw the assembly drawing and sectioned views of pipe joint.
- 4.6. Explain the use of packing material in joint.

## **5.0 Appreciate welded fabrication drawing.**

- 5.1. Identify the different types of welds and their symbolic representation as per B.I.S., SP-46-1988.
- 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. Prepare a working drawing of welded fabrications.

## **COURSE CONTENTS**

### **1.0 Introduction**

- 1.1. Importance of Machine Drawing.
- 1.2. Brief revision of 1<sup>st</sup> and 3<sup>rd</sup> 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 Rivetted joints: Types and proportions and specification of rivets :Different types of riveted joints: Lap, butt-single row, double row etc., chain and zig-zag 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 zig-zag) 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.

#### **Drawing Plate:2**

##### **Draw the views / sectional views of**

1. Jib and cotter joint assembly
2. Knuckle joint assembly
3. Assembly of muffs coupling (solid & split) coupling
4. Screw jack assembly,
5. Stuffing box.
6. Bearings.

**NOTE:** With the knowledge gained by the above exercises students must be able to draw exercises on Socket and spigot joint, protective type flanged coupling, piston of petrol engine, cross head, connecting rod, eccentric, flexible coupling, universal coupling, sleeve and cotter joint, Oldham's-coupling, lathe tool post, big end of a connecting rod, foot step bearing, Plummer block, lathe tail stock.

#### **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.
3. Cast iron flanged pipe joint, spigot and socket joint, hydraulic pipe joint, expansion joint, screwed joint, union joint - draw half sectional elevation and end view.

#### **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 Kode 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 an stud welds.
- 5.4. Supplementary symbols and special instructions: surface of reference line; as per I.S. standards with reference to fillet, V-Butt an stud welds.
- 5.5. Dimensions of welds : length, location and spacing of welds as per I.S., B.I.S., 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-46-1988.
3. Preparing working drawing of welding fabrication from given data.

#### **REFERENCE BOOKS**

1. T.S.M & S.S.M in respect of Technical Drawing by TTTI, Madras
2. Machine Drawing by A.C. Parkinson.
3. Machine Drawing by Jones & Jones.
4. Machine Drawing by N.D. Bhat.
5. A text book for Technical Schools Engg. Drawing by N.C.E.R.T – B-31, Maharani Bagh, New Delhi.
6. Machine Drawing by R.B. Gupta.
7. Indian Standard Scheme of symbol for Welding by SP-46-1988.
8. Machine Drawing by K.V. Reddy.
9. Machine Drawing by G.R. Nagpal.
10. Machine Drawing by N.Siddeswar, Kannaih, Sastri.

## MECHANICAL ENGG. LAB

Subject Title	:	MECHANICAL ENGG. LAB
Subject Code	:	M – 308
Total No. of Periods	:	03
Total Periods Per Semester	:	22 ½

### TIME SCHEDULE

S. No.	Major Components	Periods
1.	Flash & Fire point tests	06
2.	Viscosity measurement	06
3.	Calorific value tests	03
4.	Carbon residue test	4 ½
5.	Flue gas Analysis	
6.	Calibration of pressure gauge	03
<b>Total No. Periods</b>		<b>22 ½</b>

### **OBJECTIVES**

*On Completion of the Course, the student should be able to:*

#### **1.0 Understand the various tests conducted on Fuels and Lubricants.**

- 1.1 Define flash and fire points of fuels and lubricants.
- 1.2 State the importance of these properties in industrial applications.
- 1.3 Distinguish between “open” and “close” tests.
- 1.4 Perform a test on the given oils and determine the properties.
- 1.5 Mention the various equipment used in the industry for determining these properties.
- 1.6 State the importance of viscosity as applied to Oils.
- 1.7 Determine the Kinematic & Absolute viscosities of any Oil.
- 1.8 Conduct experiment to determine these values.
- 1.9 State the effect of temperature on these properties.
- 1.10 State the units of these properties.
- 1.11 Mention the various viscometers used.
- 1.12 Explain the differences of these viscometers.
- 1.13 Draw graph between the temperature and viscosities.
- 1.14 Define Calorific value of any fuel.
- 1.15 State the differences between higher and lower Calorific values of fuels.
- 1.16 Identify the various Calorimeters for determining the Calorific values of Solid, Liquid and gaseous fuels.
- 1.17 Perform tests on bomb, Junker’s Calorimeter to determine Calorific values of solid, liquid and gaseous fuels.
- 1.18 Calculate values.
- 1.19 State the importance of Carbon residue.
- 1.20 Determine the percentage carbon residue by Conradsons apparatus.
- 1.21 State the importance of flue gas analysis.
- 1.22 Perform test on Orsat’s apparatus, and calculate the percentage composition of flue gas.

1.23 Flue gas analysis using latest electronic instruments

**2.0 Understand the need and importance of calibration of pressure gauges.**

2.1 Calibrate the given pressure gauge by using dead weight pressure gauge tests.

2.2 State the principle on which the dead weight pressure gauge tester works.

2.3 State the use of various components in the pressure gauge.

***COURSE CONTENTS***

1. Determination of flash and fire points of various fuels and lubricants using Abel's, Pensky Martin's, and Cleveland's apparatus.
2. Determination of Kinematics and Absolute viscosities of the fuel and lubricating Oils using Redwood & Saybolt viscometers.
3. Determination of Calorific values of Solid and liquid fuels using Bomb Calorimeter.
4. Determination of Calorific value of gaseous fuel by using Junker's Calorimeter.
5. Determination of Carbon residue using Conradson's apparatus.
6. Flue gas Analysis by Orsat's apparatus, and latest electronic instruments
7. Calibration of a pressure gauge using dead weight pressure gauge tester.

## ELECTRICAL ENGG. LAB

Subject Title	:	Electrical Engg. lab
Subject Code	:	M – 309
Total No. of Periods	:	03
Total Periods Per Semester	:	22 ½

### TIME SCHEDULE

S.No	Major Components	Periods
1	Study of Measuring Instruments	03
2	Measurement of 1 $\Phi$ Power	03
3	Calibration of 1 $\Phi$ Energy Meter	03
4	Speed control of D.C.Motors	03
5	Load Test on D.C Motors	03
6	Load Test on 3 $\Phi$ Induction Motors	03
7	Uses of Megger and Study of Earthing	03
8	Study of Diode and Transistor	11/2
	Total	22 1/2

### OBJECTIVES

*On the completion of course a student should be able to*

- 1) Understand the Electrical circuit diagram and get familiarised with the use of electrical instruments, equipment's, etc.,
- 2) Calculate the power in A.C. circuit with voltmeter and ammeter and compare with wattmeter readings.
- 3) Measure energy and calibrate energy meter in A.C., single phase circuits.
- 4) Vary the speed of motor by field control and armature control method.
- 5) Draw the Speed-torque, Load-Torque and Load-efficiency characteristics of Motors.
- 6) Know the application of 3 phase induction motors.
- 7) Use of megger to measure insulation resistance & continuity.
- 8) Study of Pipe earthing & Plate earthing.
- 9) Study of Semi conductor diode, Zener diode and Transistor configurations.



## **COURSE CONTENTS**

### **Experiments to be conducted covering the following**

1. Study of moving coil and moving Iron dynamometer type measuring instruments and accessories used in Electrical Laboratory.
2. Study of power, power factor, ideal and reactive component of current at different applied voltages for R.L. Circuit.
3. Measurement of Energy in single phase A.C circuit and to draw calibration curves.
4. Measurement of power in A.C. Circuit (using voltammeter and Wattmeter) and to draw calibration curves.
5. Obtain Voltage and current relations in 3 phase circuits ( Star and Delta)
6. Measure insulation resistance of machines by using Megger.
7. Speed control of D.C Shunt motor by a) Armature control method  
b) Field control method
8. Load characteristic of D.C. Shunt generator.
9. Load characteristic of D.C. Shunt motor.
10. Load characteristic of D.C. Series motor.
11. Load test on 3 Phase Induction motor and draw performance curves,
12. Load test on single phase induction motor to draw load efficiency curve.
13. Battery charging at constant voltage and at constant current.
14. i) Study of Semi Conductor diode & Zener diode.  
ii) Study the input and output characteristics of following  
Transistor configurations a) CB b) CE

## **CAD LAB-I**

<b>Subject Title</b>	<b>:</b>	<b>CAD LAB-I</b>
<b>Subject Code</b>	<b>:</b>	<b>M-310</b>
<b>Periods/ week</b>	<b>:</b>	<b>03</b>
<b>Periods per Semester</b>	<b>:</b>	<b>45</b>

### **OBJECTIVES**

1. AutoCAD Screen and various Tool bars and menus.
2. The usage of draw and modify Tool bar.
3. Use of various commands like mirror, rotate, array and move and draw simple mechanical components.
4. Explain about Dimensioning and Hatching.
5. Draw the 2D – drawings Knuckle joint, screw jack, flange coupling, lathe tool post, eccentric etc.
6. Explain about 3D solids and solids tool bar options.
7. Drawing of 3D components - Bolt & Nut, Screw jack.
8. Rendering of 3D images.

### **COURSE CONTENTS**

1. Study the Auto cad screen, various toolbars and menus.
2. Exercise on usage of Draw and modify tool bar.
3. Exercise on mirror, rotate, Array and Move commands.
4. Exercise on Dimensioning and Hatching.
5. Draw the Knuckle joint with full details & dimensioning.
6. Draw the screw jack 2D drawing
7. Study the 3D solids and solids tool bar options.
8. Draw Bolt and Nut in 3D.
9. Draw various parts of screw jack in 3D and assemble them as 3D component.
10. Render the 3D images already generated and apply materials and Lights.

## WORKSHOP PRACTICE-II

<b>Subject Title</b>	:	<b>workshop practice-II</b>
<b>Subject Code</b>	:	<b>M – 311</b>
<b>Periods Per Week</b>	:	<b>03</b>
<b>Periods Per Semester</b>	:	<b>45</b>

### **OBJECTIVES**

*On the completion of the course the student should be able to:*

#### **1.0 Understand the concepts of foundry**

- 1.1 Know the sand moulding procedures in a foundry.
- 1.2 Prepare a mould sand mix.
- 1.3 Identify various foundry shop's hand tools.
- 1.4 Prepare mould in two boxes, three boxes.
- 1.5 Prepare a mould ready for casting with proper provision, of runners, risers gates

#### **2.0 Know the working of Lathe and be in a position to operate the same.**

- 2.1 Perform a plain turning operation on a lathe machine.
- 2.2 Select proper tool to perform the job.
- 2.3 Make use of various measuring instruments for taking dimensions.
- 2.4 Perform step turning operations on a lathe.
- 2.5 Calculate the taper angle.
- 2.6 Know the different taper turning methods on a lathe
- 2.7 Turn the required tapers by swiveling the compound rest.
- 2.8 Produce articles of industrial application such as ring gauges, plug gauges, handle etc.

#### **3.0 Welding**

- 3.1 Handle the gas welding torch for welding
- 3.2 Handle the Electrode Holder for laying welding beads.
- 3.3 Understand the operation of welding transformer and generator.
- 3.4 Perform various welding joint operations.

### **COURSE CONTENTS**

#### **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
- 2.7 Preparation of machine handle

### **3. Welding**

- 3.1 Gas welding
- 3.2 Layout of Beads
- 3.3 Butt joints.
- 3.4 Lap joints.
- 3.5 T-Joints

## **4<sup>TH</sup> SEMESTER**

### ENGLISH-III

**Subject Title** : **English-III**  
**Subject Code** : **M-401**  
**Periods/Week** : **03**  
**Periods per semester** : **45**

#### TIME SCHEDULE


**Course Contents:**

- Activities that improve situational interaction
- Activities that improve cooperative learning and soft skills.

**Course Material:**

The Communications Skills laboratory Manual presently in use may be continued by choosing Six to Ten Units. The manual is supported by CD for audio output.

**Scheme of Examination:**

Name of Subject	Instruction periods per week	Total periods per Semester	Scheme of Examination			
			Duration	Sessional marks	End Exam marks	Total
Enhancing English and Employability Skills level-III	3	45	3 Hours	20	30	50

## MANUFACTURING TECHNOLOGY - II

Subject Title	:	Manufacturing Technology-II
Subject Code	:	M – 402
Periods Per Week	:	05
Periods Per Semester	:	75

### TIME SCHEDULE

S.No	Major Topics	Number of Periods	Weightage of Marks	Short Answer Questions	Essay Type Questions
1	Milling & Gear Making	20	29	03	02
2	Grinding and finishing processes	15	21	02	1 ½
3	Modern Machining Process	10	13	01	01
4	Plastic processing	08	13	01	01
5	Press Tools, Jigs and Fixtures	17	26	02	02
6	Jig Boring	05	08	01	½
	Total	75	110	10	08

### OBJECTIVES

On the completion of the course the student should be able to

#### 1.0 Milling and Gear Making

- 1.1 Explain the principle of working of a Milling machine.
- 1.2 Classify the milling machines.
- 1.3 Illustrate the constructional details.
- 1.4 Explain the functions of each part of the machine.
- 1.5 Describe the various milling operations.
- 1.6 Identify the different milling cutters.
- 1.7 Select the tool and work holding devices.
- 1.8 Explain the different indexing methods.
- 1.9 Explain the specifications of milling machines.
- 1.10 Identify the different methods of producing gears.
- 1.11 Illustrate gear shaping.
- 1.12 Sketch the gear hob.
- 1.13 Identify the various components of hobbing m/c.
- 1.14 Describe the working of the above m/c.
- 1.15 List out the sequence of operations in generating gear by gear hobbing m/c.
- 1.16 Explain the different methods of finishing & checking gear teeth dimensions.
- 1.17 Specify the gears.
- 1.18 Identify the gear materials.
- 1.19 State the different heat treatment processes applied to gears.



## **2.0 Grinding and finishing Processes**

- 2.1 Explain the principle of metal removal by grinding.
- 2.2 Identify different abrasives.
- 2.3 Explain the bonds and grinding wheel manufacturing processes.
- 2.4 Identify the grinding wheel from the standard code (Marking system or designation of wheel).
- 2.5 State the factors for selecting the grinding wheels.
- 2.6 State the methods of grinding.
- 2.7 Classify the grinding machines.
- 2.8 Illustrate the cylindrical, surface, tool and cutter grinders.
- 2.9 Identify the different work holding devices.
- 2.10 State the methods of wheel maintenance.
- 2.11 State different finishing processes by grinding.( Honing, Lapping, Superfinishing)
- 2.12 Explain the principle of electro-plating with a sketch.
- 2.13 Explain the principle of hot dipping processes namely galvanising, tin coating, Parkerizing and anodising.
- 2.14 Describe organic coatings.
- 2.15 State the principles of metal spraying.
- 2.16 State the features of wire process and powder process.
- 2.17 Select the appropriate process for surface roughness of a given application.

## **3.0 Modern Machining Processes.**

- 3.1 Distinguish between non-conventional machining processes and traditional methods.
- 3.2 State their relative advantages.
- 3.3 Explain the principle of working of ultrasonic machining.
- 3.4 Identify the equipment used in U.S.M. processes.
- 3.5 Explain the principle of electric discharge machining with sketch.
- 3.6 Explain Abrasive jet machining with sketch
- 3.7 Explain Laser beam machining with a sketch

## **4.0 Plastic Processing.**

- 4.1 Indicate the principle of manufacturing plastic products.
- 4.2 Illustrate the methods of injection moulding, compression moulding, transfer moulding
- 4.3 Explain the principle of extruding, casting and calendaring.
- 4.4 Indicate the principle of machining and welding plastics.
- 4.5 Identify the different fabrication methods viz., sheet forming, blow moulding, laminating and reinforcing.
- 4.6 Know Engineering applications of plastics.

## **5.0 Press Tools, Jigs and Fixtures.**

- 5.1 Importance of Press Tools
- 5.2 Classification of presses- based on power and design of frame.
- 5.3 Illustrate the constructional details of a power press.
- 5.4 Meaning of Press size.
- 5.5 Press Tools – Punch and die.

- 5.6 Die-clearance- Die Accessories
- 5.7 Understand shear action in die cutting operation – Punch and die clearances, Angular clearance, centre of pressure, cutting forces.
- 5.8 Explain different types of dies.
- 5.9 Understand various die operations
- 5.10 Advantages of Jigs and Fixtures
- 5.11 Differentiate between jigs and fixtures.
- 5.12 Types of jigs and their constructional details
- 5.13 General considerations in design of drill jigs
- 5.14 Function of drill bush.
- 5.15 Identify different types of fixtures and their constructional details.
- 5.16 Explain basic principle of location.
- 5.17 Identify different locating methods and devices.
- 5.18 Understand basic principle of clamping.
- 5.19 Identify different types of clamps and their constructional details.

## **6.0 Jig Boring.**

- 6.1 Indicate the situation where jig-boring machines are needed.
- 6.2 Illustrate the principle of working of a jig boring machine.
- 6.3 Explain button boring on lathes.
- 6.4 Classify the jig boring machines.
- 6.5 Show the constructional details of open front machine and cross rail type machine.
- 6.6 Explain the function of above machines.
- 6.7 Describe the systems of location of holes.

## **COURSE CONTENTS**

### **1. Milling and Gear Making**

- 1.1 Introduction.
- 1.2 Types of milling machines: plain, Universal, vertical, constructional details – specifications.
- 1.3 Milling operations
- 1.4 Indexing: simple, compound and Differential indexing.
- 1.5 Milling cutters – types – nomenclature of teeth – teeth materials
- 1.6 Tool Signature of Milling cutter.
- 1.7 Tool & work holding devices.
- 1.8 Manufacture of gears – by casting, moulding – stamping - coining – extruding- rolling – Machining.
- 1.9 Gear generating methods: Gear Shaping with pinion cutter & rack cutter
- 1.10 Gear hobbing – Description of gear hob – Operation of gear hobbing machine.
- 1.11 Gear finishing processes.
- 1.12 Gear materials and specification.
- 1.13 Heat treatment processes applied to gears.

### **2.0 Grinding and finishing processes**

- 2.1 Introduction – principles of Metal Removal by Grinding.
- 2.2 Abrasives – Natural & Artificial.

- 2.3 Bonds and binding processes: Vitrified, silicate, shellac, rubber, bakelite.
- 2.4 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.
- 2.5 Standard marking systems: Meaning of letters & numbers sequence of marking – Grades of letters.
- 2.6 Grinding machines – classification: Cylindrical, Surface, Tool & Cutter grinding machine- construction details – relative merits.
- 2.7 Principle of centreless grinding
- 2.8 Advantages & limitations of centreless grinding
- 2.9 Work- holding devices.
- 2.10 Wheel maintenance – Balancing of wheels – Dressing and trimming of grind wheels: Coolants used.
- 2.11 Finishing by grinding: Honing, Lapping, Super finishing
- 2.12 Electroplating – Basic principles – Plating metals – applications.
- 2.13 Hot dipping: Galvanizing, Tin coating, parkerising, Anodizing.
- 2.14 Metal spraying: wire process, powder process and applications.
- 2.15 Organic coatings: Oil base Paint, Lacquer base, Enamels, Bituminous paints, rubber base coating.
- 2.16 Finishing specifications.

### **3.0 Modern Machining Processes.**

- 3.1 Introduction – comparison with traditional machining.
- 3.2 Ultrasonic machining - principle – Description of equipment - applications.
- 3.3 Electric Discharge Machining: Principle – Description of equipment – Type of EDM Processes - applications.
- 3.4 Abrasive jet machining – principle – description of equipment – application.
- 3.5 Laser beam machining - principle – description of equipment – application.

### **4.0 Plastics Processing.**

- 4.1 Processing of plastics:
  - 4.1.1 Injection moulding
  - 4.1.2 Compression moulding
  - 4.1.3 Transfer moulding
  - 4.1.4 Extruding
  - 4.1.5 Casting
  - 4.1.6 Calendering
- 4.2 Fabrication methods:
  - 4.2.1 Sheet forming methods
  - 4.2.2 Blow moulding
  - 4.2.3 Laminating plastics ( sheets, rods & tubes)
- 4.3 Tool angles for machining plastics
- 4.4 Coolants used in machining of plastics.
- 4.5 Applications of Plastics

### **5.0 Press Tools, Jigs and Fixtures:**

- 5.1 Introduction
- 5.2 Types of Presses – hand, power, gap, inclinable, adjustable, horn, straight side, pillar presses.
- 5.3 Constructional details of a power press.
- 5.4 Press size.

- 5.5 Press Tools – Punch and die
- 5.6 Die Accessories – Stops, Pilots, strippers, Knock outs, pressure pads.
- 5.7 Shear action in die cutting operation – punch and die clearance and angular clearance, centre of pressure, cutting forces.
- 5.8 Press working operations: blanking, piercing and forming, lancing, cutting off and parting, notching, shaving, trimming, embossing, beading and curling, bulging, twisting, coining, swaging, hole flanging or extruding – line sketches and meaning of terms.
- 5.9 Sheet metal bending: bending methods, spring back, bend allowance, bending pressure – sketches and empirical formulae.
- 5.10 Types of dies meaning of inverted, progressive, compound and combination dies.
- 5.11 Material selection for punch and die.
- 5.12 Definition of jig
- 5.13 Types of jigs: leaf jig, box and handle jig, template jig, plate jig, Indexing jig, Universal jig, vice jigs.
- 5.14 Explain the constructional details of the above jigs.
- 5.15 General consideration in the design of drill jigs
- 5.16 Explain drill bush
- 5.17 Types of fixtures : vice fixtures, milling fixtures, boring fixtures, grinding fixtures.
- 5.18 Explain the constructional details of the above fixtures.
- 5.19 Basic principles of location.
- 5.20 Explain the locating methods and devices
- 5.21 Explain the basic principles of the clamping.
- 5.22 Types of clamps : strap clamps, cam clamps, screw clamps, toggle clamps, hydraulic and pneumatic clamps.

## 6.0 Jig Boring.

- 6.1 Introduction.
- 6.2 Button boring on lathes.
- 6.3 Jig boring on vertical milling machine.
- 6.4 Types jig boring machines:-
  - a) Open front machine.
  - b) Cross rail type machine constructional details & their working.
- 6.5 System of location of holes.

## REFERENCE BOOKS

Production Technology	-	R.C.Patel
Production Technology	-	Jain & Gupta.
Gear Technology	-	Charrathi
A Text Book of Production Engg.	-	Dora
Production Technology-II	-	P.Niranjan Rao, P.Ragaiah,
Tool Design	-	Donaldson

## STRENGTH OF MATERIALS

Subject Title	:	Strength of Materials
Subject Code	:	M-403
Periods/Week	:	05
Periods per Semester	:	75

### TIME SCHEDULE

S No.	Major Topics	No. of Periods	Weightage of Marks	Short answer Questions	Essay type Questions
1	Simple Stresses and Strains	18	26	02	02
2	Strain energy	08	13	01	01
3	Shear Force and bending moment	17	26	02	02
4	Theory of Simple bending & Deflection of Beams	13	16	02	01
5	Torsion in Shafts & Springs	13	21	02	1 ½
6	Thin Cylinders	06	08	01	½
	<b>Total</b>	<b>75</b>	<b>110</b>	<b>10</b>	<b>08</b>

OBJECTIVES: On the completion of the course student should be able to

### 1.0 Simple Stresses and Strains

- 1.1. Define the strength, Mechanical properties of Engineering materials, commonly used.
- 1.2 Identify the nature and effect of tensile, compressive and shear forces.
- 1.3 Define the terms stress, strain, module of elasticity, poisson's ratio.
- 1.4 Draw typical stress Vs strain curve for a M.S. Specimen under tension indicating salient points on it.
- 1.5 Mention the significance of Factor of Safety.
- 1.6 Compute stress and strain values in bodies of uniform section and of composite section under the influence of normal stresses
- 1.7 Calculate thermal stresses, in bodies of uniform section and composite sections.
- 1.8 Write down the relation between elastic constants E,N,K,& 1/m.
- 1.9 Compute changes in axial, lateral and volumetric dimensions of bodies of uniform sections under the action of normal forces.

### 2.0 Strain Energy

- 2.1 Define resistance, proof – resilience and modulus of resilience.
- 2.2 Derive an expression for the strain energy.
- 2.3 Obtain expressions for instantaneous stress developed in bodies subjected to
  - i) gradual load.

- ii) Sudden load
  - iii) Impact/shock load.
- 2.4 Comparison of proof resilience in bodies subjected to same shock.

### **3.0 Shear Force and Bending moment Diagrams**

- 3.1 List the types of beams.
- 3.2 List the types of loading
- 3.3 Explain the terms shear force and bending moment.
- 3.4 Compute Shear stress and Bending moment at any section of symmetrically loaded beams
- 3.5 Calculate the values of S.F. and B.M.
- 3.6 Draw the diagrams of S.F. & B.M.

### **4.0 Theory of Simple Bending and Deflection of Beams**

- 4.1 State the theory and terms of simple bending.
- 4.2 Derive the bending equation  $M / I = f / y = E / R$
- 4.3 List the assumptions in theory of Simple Bending.
- 4.4 Calculate Bending stress, modulus of section and Moment of resistance.
- 4.5 Calculate the safe load and safe span and dimensions of cross section.
- 4.6 Define and explain the deflection.
- 4.7 State the formula for deflection in cantilever and simply supported beams.
- 4.8 Calculate the values of deflection in the given beams.

### **5.0 Torsion in Shafts and Springs**

- 5.1 Function of Shaft
- 5.2 Explain Polar M.I. of solid and hollow shaft
- 5.3 Derive the torque equation  $T / J = fs / R = G\theta / L$
- 5.4 Simple problems on torsion of shafts.
- 5.5 Definition of spring
- 5.6 Types of springs
- 5.7 State the formula for deflection of helical spring and laminated spring
- 5.8 Definition of stiffness of a spring
- 5.9 Design of helical spring and Laminated spring.

### **6.0 Thin Cylindrical Shells**

- 6.1 Definition of longitudinal and hoop stress
- 6.2 Expression for longitudinal and hoop stress for seamless and seam shells.
- 6.3 Design of thin cylindrical shells.

## **COURSE CONTENTS**

### **1 Simple Stress and Strains**

- 1.1 Mechanical Properties of common Engineering materials.
- 1.2 Types of Forces.
- 1.3 Stress, Strain and their nature.
- 1.4 Significance of various points on stress – strain diagram
- 1.5 Significance of factor of safety
- 1.6 Behaviour of M.S. Specimen subjected to tensile test.
- 1.7 Relation between Elastic constants.
- 1.8 Calculation of Lateral and volumetric strain of uniform sections subjected to normal forces.

1.9 Temperature (Thermal) stresses.

## 2 Strain Energy

2.1 Strain Energy or Resilience – Proof resilience – modulus of resilience.

2.2 Derive the expression for strain energy for the following cases

a) Gradual loading.

b) Sudden loading

c) Impact loading & shock loading.

2.3 Related numerical problems.

## 3. Shear Force & Bending moment Diagram

3.1 Types of beams with examples.

a) Cantilever,

b) Simply Supported,

c) Continuous,

d) Fixed.

3.2 Types of Loads.

3.3 Definition and explanation of shear force and bending moment.

3.4 Calculation of shear force and bending moment and drawing the diagrams by the analytical method only for the following cases.

a) Cantilever with point loads.

b) Cantilever with uniformly distributed load.

c) Simply supported beam with a point load at the centre and with two or more point loads.

d) Simply supported beam with uniformly distributed load.

e) Over –hanging beam with point loads, at the centre and at free ends.

f) Over – hanging beam with uniformly distributed load throughout.

g) Combination of point and U.D.L. for the above and problems there upon.

## 4. Theory of Simple Bending and Deflection of Beams

4.1 Explanation of terms

a) Neutral layer

b) Neutral Axis

c) Modulus of Section

d) Moment of Resistance

e) Bending stress.

f) Radius of curvature.

4.2 Bending Equation  $M / I = F / Y = E / R$  with derivation.

4.3 Assumptions in theory of Simple Bending.

4.4 Problems involving calculations of Bending Stress modulus of section and moment of resistance.

4.5 Calculation of safe loads and safe span and dimensions of Cross section.

4.6 Definition and Explanation of deflection as applied to beams.

4.7 Deflection formula without proof for cantilever and simply supported beams with point load and uniformly distributed load only (Standard cases only).

4.8 Related numerical Problems.

## 5 Torsion in Shafts and Springs

5.1 Definition and function of shaft

5.2 Calculation of polar M.I. for solid and hollow shaft.

- 5.3 Derivation of formulae  $T / J = \tau / R = G\theta / L$
- 5.4 Stress distribution in shafts due to torsion and simple problems to calculate stress in shafts.
- 5.5 Definition and application of springs
- 5.6 Classification of springs and description of helical and leaf springs.
- 5.7 Formula for deflection of helical spring without proof.
- 5.8 Explanation about stiffness of a spring
- 5.9 Related numerical problems on helical spring for calculating safe load, deflection, Size of coil and number of coils for given shear stress.

## **6 Thin Cylindrical Shells**

- 6.1 Explanation of longitudinal and hoop stresses in the light of circumferential and longitudinal failure of shell.
- 6.2 Derivation of longitudinal and hoop stress equation for seamless and seam shells.
- 6.3 Related numerical Problems for safe thickness and safe working pressure.

### **REFERENCE BOOKS:**

- 1. Strength of Materials by R.S. Khurmi
- 2. Strength of Materials by Ramamrutham



## ENGINEERING MATERIALS

Subject Title	:	Engineering Materials
Subject Code	:	M-404
Theory Periods	:	05
Periods Per Semester	:	75

### TIME SCHEDULE

Sl. No.	<u>Major Topics</u>	No. of Periods	Weightage of Marks	Short answer Questions	Essay Type Questions
1	Introduction Mechanical properties of engineering materials,	04	05	--	1/2
2	Testing of materials	08	13	01	01
3	Structure of Materials	08	13	01	01
4.	Production of Iron and Steel	10	13	01	01
5.	Iron Carbon Equilibrium Diagram	12	16	02	01
6.	Heat treatment of Steel	12	16	02	01
7.	Ferrous, Non Ferrous Metals and their alloys	14	21	02	1 1/2
8.	Powder Metallurgy	07	13	01	01
	<b>Total</b>	<b>75</b>	<b>110</b>	<b>10</b>	<b>08</b>

### OBJECTIVES

*On completion of the subject the student should be able to*

#### 1.0 Introduction ,Mechanical properties of engineering materials,

- 1.1 State the importance of various Engineering Materials used in Mechanical processes/ industries..
- 1.2 List the various engineering materials and their applications.
- 1.3 Define the following Properties. i) Tensile , compressive and shear strength ii) Ductility iii) Hardness iv) Toughness v) Brittleness vi) Impact strength vii) Fatigue and Creep strength

#### 2.0 Testing of Materials

- 2.1 Differentiate between destructive and non-destructive tests.
- 2.2 Describe the testing procedure for tensile strength, compression strength, shear strength, Impact strength, hardness of metals.
- 2.3 Describe the procedure for Testing Materials by X- Ray, gamma – Ray, Magnaflux, Ultrasonic and penetrants test.

### **3.0 Structure of materials**

- 3.1 State the meaning of space lattice.
- 3.2 Define unit cell.
- 3.3 Describe the three main types of space lattice.
- 3.4 State the formation of grains by dendritic growth.
- 3.5 State the effect of rate of cooling on grain formation.
- 3.6 State the effect of grain size on mechanical properties.
- 3.7 Identify the factors promoting grain size.
- 3.8 Identify important stages in the phenomenon of recrystallisation.

### **4.0 Production of Iron and Steel**

- 4.1 Name the various raw materials required for production of iron.
- 4.2 Describe the method of producing Pig Iron in Blast furnace.
- 4.3 Describe the puddling furnace to produce wrought iron.
- 4.4 Explain the process the manufacturing cast iron in a Cupola.
- 4.5 Describe the steps in manufacturing steel by Bessemer process, L.D. process, Open Hearth and Electric Process.

### **5.0 Iron - Carbon Equilibrium Diagram**

- 5.1 Explain the cooling curves of pure metal.
- 5.2 Identify the allotropic forms of pure iron with temperatures, their crystal structures.
- 5.3 Draw the iron carbon diagram, identify various structures of the iron carbon system.
- 5.4 Locate Eutectic, peritectic and Eutoctiod points from the Iron Carbon diagram.
- 5.5 Obtain the composition of phases in a steel/cast Iron from the iron carbon diagram.

### **6.0 Heat Treatment Processes of Steel.**

- 6.1 State the importance of heat treatment for steels.
- 6.2 Describe the main features of the various heat treatment operations.
- 6.3 Differentiate Annealing and normalising.
- 6.4 Describe the effect of cooling rate in hardening.
- 6.5 State the importance of tempering.
- 6.6 Explain use of case hardening processes like; carburising, nitriding and cyaniding
- 6.7 Describe TTT curves.
- 6.8 Understanding Sub Zero treatment and Vacuum Hardening

### **7.0 Ferrous, Non-Ferrous Metals and their alloys**

- 7.1 Classification of Cast Iron – Grey, White, Malleable, Spheroidal – composition, properties and applications.
- 7.2 State the basis of classification of plain carbon steels.
- 7.3 List out the application of these steels.
- 7.4 Describe the need for alloying the steel with other elements.
- 7.5 State the composition, properties, industrial applications of alloy steels.
- 7.6 Identify the need for non-ferrous metals and their alloys in Engineering application.
- 7.7 Describe the properties of –Copper, Aluminum, Tin, Zinc, lead, Nickel, Magnesium and Chromium.

- 7.8 Indicate the composition, properties, and industrial application of the important – non-ferrous alloys.
- 7.9 Identify the properties of a bearing metals.

### **8.0 Powder Metallurgy.**

- 8.1 Explain the applications of powder metallurgy as a primary manufacturing process.
- 8.2 State the important characteristics of metal Powders.
- 8.3 Explain the methods of producing powders.
- 8.4 Explain the processes of forming to shape, pressing, centrifugal compacting, extruding, gravity sintering, rolling, isostatic moulding, explosive compacting, , hot pressing, spark sintering.
- 8.5 Explain the finishing operations.
- 8.6 State the advantages and limitations of powder Metallurgy.

## **COURSE CONTENTS**

### **1.0 Introduction , Mechanical properties of engineering materials**

- 1.0 A few Mechanical Engineering Materials, Importance of their study with applications.
- 1.1 Various mechanical properties of engineering materials.
- 1.2 Tensile strength, Compressive strength, Ductility, Malleability, Hardness, Toughness, Brittleness, Impact strength, Fatigue, Creep resistance

### **2.0 Testing of materials.**

- 2.4 Destructive testing tests on UTM to determine tensile, compressive and shear strengths – Tests on Brinell & Rock Well hardness test – Impact test on Izod & Charpy tester.
- 2.5 Non destructive testing – Procedure for testing materials by X-ray, gamma ray, magnetic flux and ultrasonic testing.

### **3.0 Structure of Materials**

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

### **4.0 Production of Iron and Steel.**

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

### **5.0 Iron - Carbon Equilibrium Diagram.**

- 5.1 Cooling curve for pure metal.
- 5.2 Allotropic forms of pure Iron.

5.3 Iron carbon equilibrium diagram.

## 6.0 Heat Treatment of Steels.

6.1 Importance of heat treatment.

6.2 Heat treatment processes – Annealing, Normalising, hardening, tempering, carburising, Nitriding and cyaniding. With specific examples of Engineering applications of the above.

6.3 Sub Zero treatment – its importance.

6.4 Vacuum hardening – its importance.

## 7.0 Ferrous, Non- Ferrous and their Alloys.

7.1 Classification of Cast Iron – Grey, White, Malleable, Spheroidal – Composition properties applications.

7.2 Plain Carbon Steels: Effect of carbon in steels, Soft, Mild, Medium and High carbon and also their properties and applications.

7.3 Alloy Steels: Nickel Steels, Chromium steels, 18/8 stainless steel, High Speed Steels, Manganese Steel.

7.4 Properties and uses of Copper, Aluminium, Tin, Zinc, Lead, Nickel, Magnesium and Chromium.

7.5 Muntz metal, Admiral metal, Phosphour Bronze, Gun Metal.

7.6 Aluminum Bronze, Constantan, Monel Metal.

7.7 Properties of Bearing metals, Babbit metals.

## 8.0 Powder Metallurgy.

8.1 Primary manufacturing process – definition, Important characteristic of metal powders,

8.2 Methods of producing powders.

8.3 Forming to shape – pressing, centrifugal compacting., Extruding, Gravity sintering, Rolling, isostatic moulding explosive compacting, , sintering, Hot pressing, spark sintering,

8.4 Finishing operation.

8.5 Advantages and limitations of powder metallurgy.

## REFERENCE BOOKS

Engineering Metallurgy	by	S.P.Nayak.
Engineering Metallurgy	by	Dr. Swaroop.
Material Science	by	Hazra Chowdary.
Engineering Materials	by	Sushil Kumar.
Powder Metallurgy	by	T.T.T.I, ECH
Material Science –	by	Raghavan.
Principles of Powder Metallurgy	by	Sinha.
Engineering Matallurgy	by	T.T.T.I(S.R), ECH

## THERMAL ENGINEERING-II

Subject Title	:	Thermal Engineering -II
Subject Code	:	M-405
Periods/Week	:	05
Periods per Semester	:	75

### TIME SCHEDULE

S. No.	Major Topics	Periods	weightage of Marks	Short Answer Questions	Essay type Questions
1	Internal Combustion Engines	15	21	2	1 ½
2	Air Compressors	08	13	1	1
3	Gas Turbines&Jet Propulsion	8	13	1	1
4	Elements of Automobile Engineering	10	13	1	1
5	Steam Boilers	12	16	2	1
6	Steam Nozzles	08	13	1	1
7	Steam turbines	14	21	2	1 ½
	<b>Total</b>	<b>75</b>	<b>110</b>	<b>10</b>	<b>08</b>

## OBJECTIVES

On the completion of the course, the student should be able to

### 1.0 Comprehend the construction, working and performance of internal combustion engines.

- 1.1 Define "Heat Engine".
- 1.2 Classify heat engines.
- 1.3 Give examples for each type.
- 1.4 Summarise the advantages of internal combustion engines over external combustion engines.
- 1.5 Classification of Internal Combustion Engines
- 1.6 Draw the neat sketch of an I.C. engines and name the various parts.
- 1.7 Explain with line diagram the working of a four-stroke diesel engine.
- 1.8 Explain with a line diagram the working of a two-stroke diesel engine.
- 1.9 Explain with a neat sketch the working of a four-stroke petrol engine.
- 1.10 Explain with a neat sketch the working of a two-stroke petrol engine.
- 1.11 Compare two stroke engines with four stroke engines.
- 1.12 Compare diesel engines with petrol engines.
- 1.13 Draw the valve time diagrams for two-stroke petrol and diesel engines also draw the valve time diagram for four-stroke petrol and diesel engines.
- 1.14 Explain with a line diagram the working of a simple carburettor.
- 1.15 Explain with a line diagram the working of a zenith carburettor.
- 1.16 State the methods of cooling in I.C. engine cylinders.
- 1.17 Explain with a sketch air – cooling in I.C. engine.
- 1.18 Explain with line sketch the working of water cooling system with thermo syphon method of circulation.

- 1.19 Explain with neat sketch the working of water – cooling system with a radiator and forced circulation.
- 1.20 Compare air cooling system with water – cooling system.
- 1.21 Name the ignition systems used in petrol engines.
- 1.22 Explain with line sketch the working of a battery – coil ignition system.
- 1.23 Explain with sketch the working of a magneto ignition system.
- 1.24 Compare the battery ignition system with magneto ignition system.
- 1.25 Name the different methods of lubricating systems in I.C. engines.
- 1.26 Explain with sketches the methods of lubricating systems in I.C. engines.
- 1.27 Name the different methods of governing I.C. engines.
- 1.28 Explain the hit and miss method governing of I.C. engines.
- 1.29 Explain the quality method of governing of I.C engines.
- 1.30 Explain with line sketch the quantity method of governing of petrol engines.
- 1.31 Explain the meaning of super charging of I.C. engines.
- 1.32 List out the objectives of super charging in I.C. engines.
- 1.33 Write the formula for brake power.
- 1.34 Write the formula for indicated power.
- 1.35 Write the formula for Mechanical Efficiency.
- 1.36 Write the formula for Thermal Efficiency.
- 1.37 Write the formula for Relative Efficiency.
- 1.38 understand Heat balance sheet.
- 1.39 Solve simple problems on the performance of I.C. engines using brake test data.

## **2.0 Comprehend the construction and working of air compressor.**

- 2.1 State the functions of air compressors.
- 2.2 Enumerate the uses of compressed air.
- 2.3 Name the different types of compressors.
- 2.4 Explain with line diagram the working of a single reciprocating air compressor.
- 2.5 Write the formula for work done and power required by a single stage compressor.
- 2.6 Solve simple problems on single acting reciprocating air compressors.
- 2.7 State the advantages of multi- stage compressors over single stage compressor.
- 2.8 Explain the use of inter cooler.
- 2.9 State the conditions for minimum work done in two stage compression.
- 2.10 Write the formula for work done and power required in two stage compressor.
- 2.11 Solve simple problems in two stage air compressor.
- 2.12 Name the types of rotary compressors.
- 2.13 Explain with line diagram the working of a centrifugal compressor.
- 2.14 Explain with line diagram the working of an axial flow type compressor.
- 2.15 Explain with line sketch the working of a vane type compressor.

## **3.0 Understand the working and applications of Gas turbines & Jet Propulsion**

- 3.1 Give broad classification of gas turbines.
- 3.2 Mention the applications with limitations of gas turbine.
- 3.3 Explain with line diagrams the working of an open cycle constant pressure type gas turbine.
- 3.4 Explain with line diagram the working of a closed cycle type gas turbine.
- 3.5 Represent cycle of operation for the above type on P-V and T-s diagrams.

- 3.6 Explain with line diagram the principles of operation of Ramjet engine , turbo- jet engines.
- 3.8 Explain with line sketches the working of rocket engine.

#### **4.0 Elements of Automobile Engineering :**

- 4.1. Identify various components of an automobile .
- 4.2. Explain the function of basic structure, power plant, transmission
- 4.3. system, auxiliaries, controls of the automobiles
- 4.4. Understand the term Transmission. Functions of transmission system
- 4.5. Concept of total resistance to the vehicle motion - tractive effort-
- 4.6. Mechanical operation of clutch .Principle of friction clutches.
- 4.7. Functions and operation of a differential in an automobile.
- 4.8. Identify the functions of propeller shaft.
- 4.9. Explain the principle of shock absorber.
- 4.10. Objectives of vehicle suspension.
- 4.11. Principle of power steering. Steering mechanism
- 4.12. Understand the terms Front Axle and Steering.
- 4.13. State the requirements of a automobile brake.
- 4.14. Explain briefly the transfer of weight during braking operators.

#### **5.0 Understand the Working of Steam Boilers.**

- 5.1. State the function and use of boilers.
- 5.2. Draw the line diagrams of Cochran Boiler and Babcock Wilcox Boiler.
- 5.3. Explain the working of above boilers.
- 5.4. Distinguish between water tube and fire-tube boilers
- 5.5. Recognise the need of high-pressure modern boilers
- 5.6. Explain the working principle of Lamont and Benson Boilers with diagrams.
- 5.7. Identify the boiler mountings (all types).
- 5.8. Explain the function of a few mountings only (with sketches) such as pressure gauge, water level indicator, safety valve and fusible plug.
- 5.9. Identify the boiler accessories.
- 5.10. Illustrate the function of only a few accessories such as economiser, Super Heater
- 5.11. Explain the terms actual/equivalent evaporation and factor of evaporation.
- 5.12. Define boiler Power & efficiency
- 5.13. Write the formula for the above.
- 5.14. Compute the equivalent and actual evaporation from given data.
- 5.15. Solve problems on Boiler Power & efficiency
- 5.16. Draw heat balance for boiler performance
- 5.17. Explain draught systems (Natural, forced & induced) in detail.

#### **6.0 Steam Nozzles**

- 6.1. Flow of steam through nozzle.
- 6.2. Velocity of steam at the exit of nozzle in terms of heat drop analytically and by using Mollier chart.
- 6.3. Discharge of steam through nozzles
- 6.4. Critical pressure ratio with proof
- 6.5. Calculation of cross-sectional areas at throat and exit for maximum discharge
- 6.6. Effect of friction in nozzles
- 6.7. Working of steam jet injector.
- 6.8. Simple problems of nozzles.

## 7.0 Steam Turbines

- 7.1. Explain the principle of working of a turbine
- 7.2. Classification of Turbines with examples.
- 7.3. Differentiate the impulse turbines from reaction turbine
- 7.4. Principle of working of simple De-Laval turbine with a line diagram.
- 7.5. Draw velocity triangles
- 7.6. Identify various blade angles
- 7.7. Derive formula for work done, axial thrust, energy lost, power and efficiencies.
- 7.8. State the necessity of compounding a turbine.
- 7.9. Describe the methods of reducing rotor speeds with the help of diagrams (3 compounding methods)
- 7.10. Explain the working principle of Parson's Reaction Turbine with a line diagram.
- 7.11. Velocity triangle for Parson's reaction turbine.
- 7.12. Simple problems on Single stage Impulse turbines (without blade friction) and reaction turbines (including data on blade height)
  
- 7.13. State the necessity of governing a turbine
- 7.14. Explain the methods of turbine governing.

## COURSE CONTENTS

### 1.0 Internal Combustion Engines.

- 1.1 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 component parts, state the function of each part and materials used for the component parts – Cylinder, crank case, crank pin, crank, crank shaft, connecting rod, wrist pin, piston, cooling pins cylinder heads, exhaust valve, inlet valve.
- 1.2 Brief explanation on the principle of working of four-stroke diesel engine and two-stroke diesel engine.
- 1.3 Brief explanation on the principle of working of four stroke and two stroke petrol engines.
- 1.4 Comparison of two stroke engines and four stroke engines. Comparison of diesel engine and petrol engine.
- 1.5 Draw the valve time diagrams for two stroke and four stroke engines.
- 1.6 Working principle of a simple Carburettor,
- 1.7 principles of working of a Zenith Carburettor (Line sketch) and its advantages over simple carburettor.
- 1.8 Cooling system 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.
- 1.9 Ignition systems – Battery coil ignition and magneto ignition (description and working). Comparison of two systems.
- 1.10 Types of lubricating systems used in I.C. engines descriptive treatment only with line diagram.
- 1.11 Types of governing of I.C. engines – hit and miss method, quantitative method, qualitative method and combination methods of governing their applications.
- 1.12 Meaning and objectives of supercharging.



- 1.13 Formulae for B.P., F.P., I.P., mechanical efficiency, indicated thermal efficiency, air standard efficiency, relative efficiency, Morse test, Heat balance sheet, simple problems on performance of I.C. engines.

## **2.0 Air Compressors.**

- 2.1 Functions of air compressor – uses of compressed air – types of air compressors.
- 2.2 Single stage reciprocating air compressor its construction and working (with line diagram) using P.V. diagram Formulae for work done and power required- simple problems on calculation of work done and power required.
- 2.3 Multi stage compressors – advantages over single stage compressors. Use of air cooler – conditions for minimum work in two stage compressor (without proof) Formulae for work done and power required in two stage compressors – simple problems.
- 2.4 Rotary compressors – types – descriptive treatment of Centrifugal compressor, axial – flow type compressor and vane-type compressors.

## **3.0 Gas Turbines & Jet Propulsion**

- 3.1 Gas turbines – Classification – open cycle gas turbines and closed cycle gas turbines.. Applications and limitations of gas turbines.
- 3.2 Open cycle constant pressure gas turbine.
- 3.3 Closed cycle gas turbine
- 3.4 Principle of operation of Ram-jet engine and turbojet engines
- 3.5 Rocket engine – its principle of working & application.

## **4.0 Elements of automobile engineering :**

Identify various components of an automobile .Explain the function of basic structure, power plant, transmission system, auxiliaries, controls of the automobiles .Understand the term Transmission. Functions of transmission system. Concept of total resistance to the vehicle motion - tractive effort.

Mechanical operation of clutch. Principle of friction clutches. Functions and operation of a differential in an automobile. Identify the functions of propeller shaft. Explain the principle of shock absorber. Objectives of vehicle suspension. Principle of power steering. Steering mechanism

Understand the terms Front Axle and Steering. State the requirements of a automobile brake .Explain briefly the transfer of weight during braking operators. Introduction to front axle. State the requirements of a automobile brake. Explain briefly the transfer of weight during braking operators.

#### **4.0 Steam Boilers.**

- 4.1 Function and use of steam boilers.
- 4.2 Classification of steam boiler with examples.
- 4.3 Brief explanation with line sketches of Cochran and Babcock Wilcox Boilers.
- 4.4 Comparison of water tube and fire tube boilers.
- 4.5 Description with line sketches and working of modern high pressure boilers Lamont and Benson boilers.
- 4.6 Brief explanation with line sketches of boiler mountings namely, pressure gauge, water level indicator, fusible plug, blow down cock, stop valve, safety valve (dead weight type, spring loaded type, high pressure and low water safety alarm).
- 4.7 Brief explanation with line sketches of boiler accessories such as feed pump, economiser, super heater and air pre-heater only.
- 4.8 Explanation of the terms : Actual evaporation, equivalent evaporation, factor of evaporation, boiler horse power and boiler efficiency.
- 4.9 Formula for the above terms without proof.
- 4.10 Simple direct problems on the above.
- 4.11 Draught systems (Natural, forced & induced).

#### **5.0 Steam Nozzles**

- 5.1 Flow of steam through nozzle.
- 5.2 Velocity of steam at the exit of nozzle in terms of heat drop by analytical and mollier diagram.
- 5.3 Discharge of steam through nozzles.
- 5.4 Critical pressure ratio.
- 5.5 Methods of calculation of cross – sectional areas at throat and exit for maximum discharge.
- 5.6 Effect of friction in nozzles
- 5.7 Working steam jet injector.
- 5.8 Simple problems of nozzles.

#### **6.0 Steam Turbines**

- 6.1 Classification of steam turbines with examples.
- 6.2 Difference between impulse & reaction turbines.
- 6.3 Principle of working of a simple De-lavel turbine with line diagrams.
- 6.4 Velocity diagrams.
- 6.5 Expression for work done, axial thrust, tangential thrust, blade and diagram efficiency, stage efficiency, nozzle efficiency.
- 6.6 Methods of reducing rotor speed compounding for velocity, for pressure or both pressure and velocity.
- 6.7 Working principle with line diagram of a Parson's Reaction turbine – velocity diagram.
- 6.8 Simple problems on single stage impulse turbines (without blade friction) and reaction turbine including data on blade height.
- 6.9 Governing of steam turbines : Throttle, By-pass & Nozzle control governing.

**Note: As far as sketches are concerned the line diagrams of only those components mentioned in specific objectives are to be included in the examinations.**

**Reference Books:**

Thermodynamics	by	Ballaney
Elements of Heat Engines – Volume II	by	R.C. Patel & Karamchandani
Thermal Engineering	by	Arora & S. Domkundwar
Thermal Engineering	by	Roy & Sarao

## HYDRAULICS & FLUID POWER SYSTEMS

Subject Title :Hydraulics & Fluid power systems  
Subject Code : M-406  
Periods/Week : 05  
Periods per Semester : 75

### TIME SCHEDULE

S.No	Major Topics	No. of Periods	Weightage of Marks	Short answer Questions	Essay Type Questions
1	Properties of Fluids	05	13	1	1
2	Flow of Liquids	10	13	1	1
3	Flow through pipes	10	13	1	1
4	Impact of jets	10	13	1	1
5	Water Turbines	15	16	2	1
6	Pumps	10	13	1	1
7	Oil power Hydraulics	08	13	1	1
8	Pneumatics	05	13	1	1
9	Hydro-pneumatic systems	02	03	1	0
	<b>Total</b>	<b>75</b>	<b>110</b>	<b>10</b>	<b>08</b>

### OBJECTIVES

*On the completion of the study of the subject, the student should be able to*

Know the importance of Hydraulics in the present day industry and will be in a position to distinguish Hydraulics, Hydraulic Machines, fluid power systems

#### 1.0 Understand the various properties of fluids

- 1.1 Define a fluid
- 1.2 Differentiate between compressible and incompressible fluids
- 1.3 State the various units used in Hydraulics
- 1.4 Define various properties of fluids and state their units
- 1.5 Define intensity of pressure, differentiate between gauge pressure and absolute pressure .
- 1.6 Pressure and state their units
- 1.7 Explain the working principle of manometer

## **2.0 Understand the behaviour of liquids in motion**

- 2.1 Distinguish between laminar flow and turbulent flow and concept on Reynold's number.
- 2.2 State the various type of energies and the total energy.
- 2.3 Know about the velocity of a flowing liquid
- 2.4 Understand the discharge equation and equation of continuity of flow.
- 2.5 State Bernoulli's equation and its application in hydraulics
- 2.6 Solve problems (simple) on law of continuity, Bernoulli's equation, Venturimeter and pitot tube.
- 2.7 Explain the working principle of venturimeter, pitot tube, water and current meters

## **3.0 Evaluate frictional losses during flow of liquids through pipes**

- 3.1 Mention the equation for loss of head due to friction in pipes
- 3.2 State Darcy's and chezy's formulae
- 3.3 Explain the hydraulic gradient and total energy line
- 3.4 Calculate the velocity of flow, discharge and diameter of pipes connecting two reservoirs
- 3.5 Explain the function of siphon and give reason for limiting the height of the pipes
- 3.6 Explain how the power can be transmitted through pipes carrying liquid under pressure
- 3.7 Express the condition for maximum H.P. through pipes
- 3.8 Solve simple problems on power transmission through pipes

## **4.0 Analyse forces during the impact of jets**

- 4.1 Derive expression for force of jet on fixed vertical, flat plate, fixed inclined flat plate, moving flat plate
- 4.2 Derive expression for the force of jet on a series of plates fixed on the rim of a wheel
- 4.3 Draw velocity triangles for fixed and moving curved blades
- 4.4 Find the expressions for work done, power and efficiency in the above

## **5.0 Understand the working of water Turbines**

- 5.1 State the importance of water turbines
- 5.2 Draw the layout of a hydroelectric power station
- 5.3 Classify the water turbines and also sub-classify them based on the direction of flow of water
- 5.4 Explain the working of Pelton wheel, Francis turbine and Kaplan turbine
- 5.5 Describe the governing of water turbines
- 5.6 Solve simple problems on water turbines

## **6.0 Know the working of pumps**

- 6.1 Explain the function of pump
- 6.2 Classify the pumps
- 6.3 Explain the principle of operation of a reciprocating pumps
- 6.4 Mention the constructional details of single acting and double acting pumps
- 6.5 Solve simple problems on power required to drive a pump
- 6.6 Explain the principle of operation of centrifugal pumps
- 6.7 Mention the constructional details of centrifugal pump
- 6.8 Compare the centrifugal pump with a reciprocating pump
- 6.9 Appreciate the importance of priming in centrifugal pump

- 6.10 Identify the effects of leakages of air, its prevention
- 6.11 Define the efficiency of a centrifugal pump
- 6.12 Explain the phenomenon of cavitation and state its effect
- 6.13 Solve simple problems on centrifugal pumps
- 6.14 Draw the layout of a centrifugal pump installation

## **7.0 Oil power Hydraulics**

- 7.1 Appreciate the use of Hydraulic control system
- 7.2 State merits and demerits of hydraulic control system.
- 7.3 State the essential components of hydraulic circuits and their functions.
- 7.4 State the purpose of intensifier.
- 7.5 State the purpose of of accumulators.
- 7.6 Explain the principle of Hydraulic Jack.
- 7.7 Explain the principle of Hydraulic crane.
- 7.8 Identify the elements of a Fluid Reservoir

## **8.0 Pneumatics**

- 8.1 State the elements of pneumatic circuits
- 8.2 State the areas of application of pneumatic power unit
- 8.3 Compare with hydraulic power unit
- 8.4 Explain the principle of working of power operator holding devices.
- 8.5 Explain the pneumatic safety circuits.

## **9.0 Hydro Pneumatic Systems**

- 9.1 Explain the advantages and applications of combined air and oil systems.
- 9.2 Explain the principle of combination system.
- 9.3 Describe the use of air as cushion for hydraulics system.

## **COURSE CONTENTS**

### **1.0 Properties of fluids**

- 1.1 Definition of fluid, compressible and incompressible fluids
- 1.2 Units used in Hydraulics
- 1.3 Density, specific weight, specific gravity, viscosity and surface tension, compressibility and capillarity.
- 1.4 Intensity of pressure, gauge and absolute pressures.
- 1.5 Measurement of pressures by U-Tube – manometer – simple problems

### **2.0 Flow of Liquids**

- 2.1 Types of Fluid flow
- 2.2 Concept on Reynold's Number – Laminar & Turbulant flow
- 2.3 Pressure, potential and kinetic energy of liquids - Total energy,
- 2.4 Bernoulli's equation (no derivation) – assumptions made
- 2.5 Continuity equation for compressible and incompressible fluids
- 2.6 Simple problems on continuity equation
- 2.7 Simple problems on Bernoulli's equation
- 2.8 Working principle of Venturimeter
- 2.9 Simple Problems on Venturimeter
- 2.10 Pitot tube – principle -applications

### **3.0 Flow through pipes**

- 3.1 Concept of loss of head in pipes due to friction

- 3.2 Darcy's & Chezy's formula (without proof)
- 3.3 Simple problems on Darcy's and Chezy's formulae
- 3.4 Hydraulic gradient line and Total energy line-illustration
- 3.5 Calculation of discharge, velocity, diameter of pipe etc., for pipes connecting two reservoirs (considering frictional losses only)
- 3.6 Siphon – principle of working (Numerical problems omitted)
- 3.7 Expression for power transmitted through pipes.
- 3.8 Expression for transmission efficiency,
- 3.9 condition for maximum efficiency (without proof.)
- 3.10 Simple problems on power transmission

#### **4.0 Impact of jets**

- 4.1 Derivation of formulae for the force of jet on Fixed vertical flat plate
- 4.2 Derivation of formulae for the force of jet on Fixed inclined flat plate
- 4.3 Simple problems on the above
- 4.4 Derivation of formulae for the force of jet on moving vertical flat plate
- 4.5 Derivation of formulae for the force of jet on series of moving plates fixed on the rim of a wheel
- 4.6 Simple problems on the above
- 4.7 Force of jet striking at the centre of Fixed curved blade –velocity triangles
- 4.8 Force of jet striking at the top of a moving curved blade - velocity triangles
- 4.9 Work done, power and efficiency in the above cases.
- 4.10 Simple problems on the above .

#### **5.0 Water turbines**

- 5.1 Introduction to water turbines
- 5.2 Table showing the various Water turbine installations in India
- 5.3 Use of water turbines
- 5.4 Hydro-electric power stations line sketch showing layout of hydro-electric power plant with head race, dam, sluice gate, pen stock turbine, generator and tail race
- 5.5 Classification of turbines-impulse and reaction turbines
- 5.6 Brief sub-classification as axial, radial and tangential flow type
- 5.7 Working principle of Pelton wheel-velocity triangles
- 5.8 Simple problems
- 5.9 Working principle of Francis turbine - velocity triangles
- 5.10 Simple problems
- 5.11 Working principle of Kaplan turbine - velocity triangles
- 5.12 Simple problems
- 5.13 Differences between Pelton wheel and Francis Turbines
- 5.14 Differences between Francis and Kaplan turbines
- 5.15 Governing of methods of Water turbines

#### **6.0 Pumps**

- 6.1 Function of a pump
- 6.2 Classification of pumps
- 6.3 Principle of operation of a reciprocating pump
- 6.4 Constructional details of single acting, double acting pumps.
- 6.5 Expression for theoretical power required to drive the pump(without proof).
- 6.6 Simple problems
- 6.7 Working principle of centrifugal pump

- 6.8 Installation of centrifugal pump, showing its mountings and other accessories
- 6.9 Priming of centrifugal pump – necessity - Cavitation and its effect
- 6.10 Simple problems on work, power and efficiency of Centrifugal pumps

## **7.0 Oil power hydraulics**

- 7.1 Introduction to hydraulic control system.
- 7.2 Merits and demerits of hydraulic control system.
- 7.3 Essential components of Hydraulics circuits and their functions.
- 7.4 Intensifiers – purpose - principle of working
- 7.5 Accumulators – purpose – principle of working
- 7.6 Hydraulic jack and Crane.
- 7.7 Elements of Fluid Reservoir – Filter, Air vent, Strainer, Baffles etc.
- 7.8 Hydraulic control valves - types

## **8.0 Pneumatics**

- 8.1 Introduction to Pneumatic control - applications
- 8.2 Comparison with hydraulic circuits
- 8.3 Principle of working of Pneumatic clamp
- 8.4 Principle of working of Pneumatic collets
- 8.5 Principle of working of Pneumatic safety circuit against overload

## **9.0 Hydro - Pneumatic System**

- 9.1 Advantages and Applications of combined Air and oil system.
- 9.2 Air controlled hydraulic valve

## **REFERENCE BOOKS**

Hydraulic Machines By S.Anantha Swamy  
 Hydraulic Machines By R.C. Patel  
 Hydraulics By Malhotra & Malhotra  
 Hydraulic Machinery By Abdulla Shareef  
 Hydraulics & Hydraulic Machinery By Yeaple  
 Hydraulics and Pneumatics By Reya and Rao.  
 Pneumatic controls by FESTO  
 Fluid Power Pneumatics by ALAN H. JOHN  
 Pneumatics by FLIPPO  
 Pneumatics By TTTI  
 Fluid Power & Pneumatics by AUDEL



## PRODUCTION DRAWING

**Subject Title** : **Production Drawing**  
**Subject Code** : **M-407**  
**Period/Week** : **03**  
**Period per Semester** : **45**

### TIME SCHEDULE

S.No	Major Topics	Number of Periods	Weightage of Marks	Short Answer Questions	Essay Type Questions
1	Introduction	03			
2	Drawing of Component s	03	40		
3	Dimensional Tolerances	06	15	1	
4	Geometrical Tolerances	06	15	1	
5	Surface finish	06	15	1	
6	Standard component specifications	03	5	1	
7	Process sheet Preparation	03	10		
8	Exercises in Production Drawing	15			02*
	<b>Total</b>	<b>45</b>	<b>100</b>	<b>04</b>	<b>02</b>

**\*NOTE :**

**1. Candidate has to answer all questions in part- A and one question from part- B out of two.**

**2. Part B question carries 40 marks and distributed for**  
**-component drawing views.....20marks,**  
**-limits fits and tolerances.....5marks,**  
**-geometrical tolerances.....5marks,**  
**-surface finish.....5marks,**  
**-process sheet .....5marks.**

**3. Standard components in part-B question need not be drawn.**  
**They are to be designated as per BIS. The marks for them are included in component drawing views**

## **OBJECTIVES**

*On the completion of the course the student should be able to*

### **Understand the need of production drawing.**

Distinguish the machine drawing from a production drawing.

State the factors that govern the preparation of a production drawing.

Identify the components of a production drawing.

List the function of the component.

Prepare the relevant views of the part and dimension the part.

Indicate the details of specific processes like, heat treatment, welding, counter boring etc.

### **Interpret dimension to obtain a fit as per BIS standards.**

State definition of fit, allowance and tolerance.

Identify tolerance zones and tolerance grades

Classify types of fits ,Material conditions, System of limits, specification of tolerances

Selection of suitable fit for a given mating part.

Compute the fit from tables.

Indicate fits on the drawings.

### **Apply geometrical tolerances to a component**

Need of geometrical tolerances, Types of geometrical tolerances

Guidelines for indication of feature controlled by geometrical tolerances

Datum features ,guidelines for indication of datum features, datum planes in space,

General principles for applying geometrical tolerances on a component

Indicate geometrical tolerances on the drawings

### **Identify the standard symbol and indication added to it, to represent surface finish.**

Indicate Profile of a surface and important characteristics of a surface ,

Identify the surface texture symbols.

Identify Lay direction,

surface roughness achievable from different manufacturing processes,

Equivalent surface roughness symbols,

Indicate the roughness values or grade number and corresponding symbol as per BIS.

Indicate surface roughness on drawings.

### **Interpret the standard component**

Identify the standard part that can be procured directly from the market and specify the part as per commercial/BIS Standards for procurement.

### **Write the process sheet of production.**

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.

### **Preparation of Production drawing exercises.**

Prepare exercises on production drawing as mentioned in the contents.

## **COURSE CONTENTS**

### **1.0 Introduction and Drawing of component.**

Need of preparing a production drawing, requirements for manufacturing a product like equipment, tools, measuring instruments depending upon processes, accuracy and finish data available in machine drawing – components of a production drawing, fits and tolerances, surface finish, specific processes, material of the component.

Read a given assembly drawing – study of the functions of the various parts of the assembly drawing.

Preparation of detailed drawing of a specified part of the assembly.

### **2.0 Limits, fits and tolerances.**

Definitions of limits, fits and tolerances.

Select dimensions from BIS standards to obtain clearance, transition and interference fits for a given set to mating parts – computation of fit and tolerance from BIS table.

Preparation of drawing of mating parts and representation of fits and tolerances.

Exercises in computing tolerance and representation on the drawings for different types of fits.

### **3.0 Geometrical tolerances**

Importance of geometrical tolerances, Types of geometrical tolerances

Tolerance of form : straightness ,flatness, roundness, cylindricity.

Tolerance of profile: profile of a line, profile of a surface.

Tolerance of orientation or attitude : angularity, perpendicularity, parallelism

Tolerance of location: position, concentricity, symmetry,

Composite tolerances : radial run-out, axial run-out

Symbols for geometrical tolerances, indication of geometrical tolerances on components.

Exercises on representation of geometrical tolerances on the drawings

### **4.0 Surface finish.**

Standard symbol of surface finish and indications added to it.

Representation of quality of surface finish on the drawing as BIS roughness grade numbers.

**Exercises** on specifying the surface roughness(average values) for functional surfaces of the following machine tool parts

-Shaft rotating in bush bearing,

-Tailstock sleeve in tailstock body,

-Keys and keyways

-Mounting surfaces for antifriction bearings

-Shaft or bush press fitted into bodies

-Beds of machine tools, guide-ways

-Contact surfaces ,example :flanges of pipe fittings

-Peripheral surfaces of pulleys and grooves for v-belts

-Surfaces of control elements example: levers ,hand wheels

-Bases of machines

-Machine tool tables

### **5.0 Specification of standard parts.**

Standard components (parts) are to be designated as per BIS

-Bolts, Nuts, Locknuts, Washers, Screws and, Studs

-Circlips

-Cylindrical and taper pins

-Keys

-Rivets

Splines

-Oil seals-rings

-Antifriction bearings:

### **6.0 Process sheets**

Sequence of processes of production for a particular product.

Specifications of relevant equipment and tools to obtain the desired accuracy and surface finish.

Selection of measuring instruments to check the accuracy.

### **7.0 Production drawing exercises.**

Prepare the relevant views of the part(s) of a given assembly drawing needed for the purpose of production.

Dimension the views obtained and indicate on it with relevant notes the specific processes.

Compute the fit from ISI tables as per the function of the component and indicate the limits at appropriate place on the drawing prepared.

Indicate the geometrical tolerances on the component drawing

Mark the surface finish symbols with indications added.

Prepare the process sheet indicating sequence of processes and equipment, tools, measuring instruments required.

**NOTE:** *In order to develop the abilities required in the preparation of production drawings in the student, the use of actual production drawing from the local industries as exercises to the students is of vital importance.*

#### **Exercises**

- ***Knuckle Joint***

- ***Universal Coupling***

- ***Eccentric***

- ***Lathe tail stock***

- ***Revolving Centre***

- ***Lathe Tool post***

- ***Drill jig***

- ***Non Return valve***

- ***Clapper Block***

- ***Stuffing box***

- ***Footstep bearing with radial and thrust ball bearing***

- ***Spindle supported by taper roller bearing***

- ***Wall bracket with a pedestal bearing***

- Hydraulic cylinder and piston**
- Crane hook**
- Belt drive**

## **REFERENCE BOOKS**

1. IS 696 – 1972-Code of Practice for General Engg. Drawing & B.I.S Code – SP . 46. IS 696 – 1988
2. Machine Design date hand book – Vol I & II – Dr. K. Lingaiah, ( Suma Publishers, Bangalore).
3. IS Code on fits and tolerances.
4. Blur print reading for Mechanical Trades by B.R.Sachdeva.
5. Machine drawing by R.B. Gupta.
6. Machine Drawing by Siddeswar.
7. Production Drawing by K.Venkat Reddy
8. Machine Drawing by Nagpal
9. Production Drawing - for CCC candidates by SBTE&T

## WORKSHOP PRACTICE-III

<b>Subject Title</b>	:	<b>Workshop practice-III</b>
<b>Subject Code</b>	:	<b>M-408</b>
<b>Periods/Week</b>	:	<b>06</b>
<b>Periods per Semester</b>	:	<b>90</b>

### OBJECTIVES

*On the completion of the course, the student should be able to*

#### **1.0 Know the working of Lathe, and will be a position to operate the same.**

- 1.1 Calculate the gear ratio for thread cutting.
- 1.2 Cut threads on a lathe machine.
- 1.3 Produce articles of industrial application such as snap gauges, plug gauges, handle etc.
- 1.4 Perform the combination of operations to produce jobs.
- 1.5 Perform special turning operations, Grinding skills of turning tool eccentric turning, male and female fit of threaded assembly

#### **2.0 Welding.**

- 2.1 Weld the material to produce. T, H, and angular joints, pipe joint.
- 2.2 Produce utility articles such as shoe rack, , stools, drawing table, dual desk tables etc

#### **3.0 Foundry**

- 3.1 Prepare a mould for connecting rod, pulleys.
- 3.2 Core preparation for hollow jobs
- 3.3 Casting, fettling of above components
- 3.4 study of cupola furnace

#### **4.0 Machine shop**

- 4.1 shaper, slotting operations
- 4.2 cutting of v-block in shaper
- 4.3 milling machine operations
- 4.4 spur gear cutting

### COURSE CONTENTS

#### **A. Turning shop**

1. Thread cutting
2. Grinding of turning tool
3. Combination of all operations.
4. Eccentric turning.
5. Male and female fit of threaded assembly

#### **B. Welding**

1. T. Joint, 2. H – Joints, 3. Angular joints.
4. 2-joints (H Joints and T Joints)

5. Shoe Rack. 6. Stools
7. drawing table, dual desk tables etc.,
8. pipe joint

### **C. Foundry**

1. Connecting rod, 2.core making 3.pulleys.4.cupola study

### **D. Machine shop**

1. shaper, slotting operations
2. cutting of v-block in shaper
3. milling machine operations
4. spur gear cutting

## MATERIAL TESTING LABORATORY

Subject Title	:	Material Testing Laboratory
Subject Code	:	M-409
Periods/Week	:	03
Periods/Semester	:	24

### Time schedule

S. No.	Name of Experiment	No of periods
1	Study of Micro Structures of Metals & Alloys	06
2	Tensile test on M.S specimen	03
3	Compression Test	
4	Impact Test & hardness tests	03
5	Torsion Test & Spring Tests	03
6	Hardness tests	03
7	Ultra sonic Testing to detect flaw is	03
8	Dye penetrant test	03
	<b>Total</b>	<b>24</b>

### OBJECTIVES

*On the completion of course a student should be able to:*

#### 1.0 Material testing Laboratory – Understand the various material testing methods.

- 1.1 Learn the method of preparing a specimen for the metallography.
- 1.2 Study and interpret the microstructure of specified ferrous and non ferrous metals.
- 1.3 Handle the metallurgical microscope to study the microstructures.
- 1.4 Define the various properties of materials such as: yield stress, Ultimate stress, percentage elongation, Young's Modulus.
- 1.5 Conduct experiments on timber to test for its compressive strength.
- 1.6 Know the method of determining the Young's modulus of material by the principle of deflection.
- 1.7 Determine the modulus of rigidity by the method of deflection of helical springs.
- 1.8 Appreciate the importance of various mechanical properties such as hardness, impact strength.
- 1.9 Perform tests to determine the above.
- 1.10 Know how to determine the flaws in a product such as casting etc using ultrasonic unit
- 1.11 Know to determine the surface flaws by Dye penetrant. test



## **COURSE CONTENTS**

1. Specimen preparation for the metallography.
2. Study of microstructures of Mild steel, pure iron, Grey cast iron, S.G. Iron, Eutectoid steel, Stainless steel, Aluminum, Brass, Bronze
3. Determination of yield stress, ultimate stress, percentage reduction, percentage elongation, Young's modulus by conducting tension test on Universal testing machine.
4. Determination of crushing strength of timber.
5. Determination of Young's Modulus by the method of deflection.
6. Determination of Modulus of rigidity of spring steel by the deflection of springs.
7. Determination of impact strength of the material using Izod and Charpy's tests.
8. Determination of hardness of metal using Brinnel and Rockwell Testing methods.
9. Detection and measurement of surface and sub-surface cracks by ultrasonic portable equipment.
10. Detection of surface defects by Dye penetrant test.

## HYDRAULICS & HYDRAULIC MACHINES LAB

<b>Subject Title</b>	:	<b>Hydraulics &amp; Hydraulics Machines Lab</b>
<b>Subject Code</b>	:	<b>M-410</b>
<b>Periods/Week</b>	:	<b>03</b>
<b>Periods/Semester</b>	:	<b>21</b>

### TIME SCHEDULE

S. No.	Name of Experiment	No of periods allotted
1	Venturimeter	3
2	Pipe Friction	3
3	Pelton Wheel	6
4	Kaplan turbine	
5	Francis turbine	
6	Reciprocating pump	3
7	Centrifugal Pump	3
8	Jet Pump	3
		21

### OBJECTIVES

*On Completion of the Course, the student should be able to:*

1. Appreciate the practical applications of venturimeter.
2. Identify the formulae used in calculation of discharge by venturimeter.
3. Know the importance of pipe friction in practical environment.
4. Know the method of evaluating pipe friction for a given pipe.
5. Know the classification of water turbines.
6. Know the principle of impulse and reaction turbines.
7. Differentiate between impulse and reaction turbines.
8. Identify the practical applications of impulse and reaction turbines.
9. Know the method of evaluating the performance characteristics of pelton wheel, Kaplan turbine, Francis turbine for a given set of input data.
10. Differentiate between a turbine and a pump.

11. Know the working principle of reciprocating pump, centrifugal pump.
12. Know the practical applications of the above pumps.
13. Know the method of evaluating the performance characteristics of the above pumps.
14. Know the working of a jet pump

### **COURSE CONTENTS**

1. Determination of Coefficient of discharge of Venturimeter.
2. Determination of major losses in pipes due to friction.
3. Determination of B.P. and efficiency of Pelton wheel.
4. Determination of B.P. and efficiency of Kaplan turbine.
5. Determination of B.P. and efficiency of Francis turbine.
6. Determination of I.P. and overall efficiency of a reciprocating pump
7. Determination of I.P. and efficiency of the Centrifugal pump
8. Study of a jet pump

## **5<sup>TH</sup> SEMESTER**

**M-501 INDUSTRIAL TRAINING**  
**(Practical Training)**

**V SEMESTER**

<b>S.NO</b>	<b>Subject</b>	<b>Duration</b>	<b>Items</b>	<b>Max Marks</b>	<b>Remarks</b>
<b>1</b>	<b>Practical Training in the Industry</b>	<b>6 Months</b>	<b>1.First Assessment (at the end of 3 rd month)</b>	<b>100</b>	
			<b>2. Second Assessment (at the end of 6th month)</b>	<b>100</b>	
			<b>3. Training Report</b>		
			<b>a) Log Book</b>	<b>30</b>	
			<b>b) Training Report</b>	<b>30</b>	
			<b>4. Seminar</b>	<b>40</b>	
			<b>T O T A L</b>	<b>300</b>	

- The industrial training shall carry 300 marks and pass marks is 50%.
- A candidate failing to secure the minimum marks should complete it at his own expenses.
- No apprenticeship training stipend is payable in such case.
- During Industrial training the candidate shall put in a minimum of 90%attendance.

# DIPLOMA IN MECHANICAL ENGINEERING (CURRICULUM C-09)

## V SEMESTER

### (INDUSTRIAL TRAINING)

Duration : 6 months

#### **OBJECTIVES**

On completion of a spell of practical training in a industry, the student will be able to

#### **1.0 Know the organizational set up from top executive to workmen level**

- 1.1 Know the function of each department/section
- 1.2 Know the inter relationship among various department/sections

#### **2.0 Know the various raw materials used as feed stock and their source.**

- 2.1 Understand the various intermediates produced and their further processing and / or waste disposal.
- 2.2 Know the final products, its composition and its commercial importance's, uses and applications.

#### **3.0 Understand the various stages involved in processing, sequential arrangement of different equipment.**

- 3.1 Draw the flow diagram, detail flow diagram of each process
- 3.2 Understand the arrangement of various equipment and machinery in systematic manner in a less possible area of site.

#### **4.0 Know the various analytical methods used in the quality control department**

- 4.1 Understand the experimental methods to find out the quality of the product
- 4.2 Understand various tools, instruments used for quality checking.

#### **5.0 Know the trouble shooting in process operation**

- 5.1 Know preventive precautions of each equipment in the plant.
- 5.2 Startup and shut down procedures for the equipment and plant.

#### **6.0 Know the importance of safety in industries**

- 6.1 Understand the safety about personnel protection, equipment protection
- 6.2 Know the usage of various safety devices
- 6.3 Precautionary measures to be taken.

#### **7.0 Know the various pollutants emitted from the plant.**

- 7.1 Understand effects of pollutants.
- 7.2 Understand treatment method and disposal.
- 7.3 Know the effective methods pollution control.

### ***COURSE CONTENTS***

- 1. Organizational set up
- 2. Raw materials, intermediates and end products
- 3. Process descriptions (Process flow diagrams and line tracing, detailed flow diagrams etc.)
- 4. Quality control of raw materials, intermediates and end products
- 5. Operational troubles and preventive measures
- 6. Safety aspects (personnel, equipment etc.)
- 7. Pollution control

## INDUSTRIAL TRAINING SCHEME V SEMESTER

1. A candidate shall be assessed twice in the spell of industrial training i.e. at the end of third month and finally before he/she completed the industrial training
2. The assessment shall be carried out by a committee comprising of
  - (a) A representative of the Industry where the candidate is undergoing training
  - (b) A staff member of the concerned section of the polytechnic.
3. The assessment at the end of the third month and the end of training shall each carry 100 marks for the progress made during the corresponding period of training.
4. The remaining 100 marks are allotted as follows:
  - For the log book 30 marks,
  - For Training report 30 marks
  - For seminar 40 marks.

These are to be evaluated at the institution at the end of training by a committee consisting following staff members (1) Head of Dept. concerned.(2) Staff member who assessed the student in the industry (3) Any other staff member of concerned department
5. The progress made during the end of assessment will be evaluated on the basis of the following parameters.

### ASSESSMENT SCHEME

S. No.	Name of the Parameter	Max. Marks Allotted for each Parameter
1.	Attendance and punctuality	5
2.	Familiarity with Technical terms	6
3.	Familiarity with tools and material	10
4.	Attitude towards job	7
5.	Manual skills	4
6.	Application of knowledge	10
7.	Problem solving skills	10
8.	Comprehension and observation	4
9.	Safety and Environmental consciousness	3
10.	Human relations	4
11.	Ability to communicate	6
12.	Supervising ability	10
13.	General conduct during the period	6
14.	Maintenance of dairy	15
	<b>Total:</b>	<b>100</b>



## **6<sup>TH</sup> SEMESTER**

## ENGLISH-IV

**Subject Title** : English-IV  
**Subject Code** : M-601  
**Periods/Week** : 02  
**Periods per semester** : 30

### TIME SCHEDULE


## INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP

**Subject Title** : Industrial Management And Entrepreneurship  
**Subject Code** : M –602  
**Periods/Week** : 05  
**Periods per Semester** : 75

### TIME SCHEDULE

S. No.	<u>Major Topics</u>	<i>Periods</i>	<i>Weightage Of Marks</i>	<i>Short Answer Question s</i>	<i>Essay Type Questions</i>
1.	Principles and functions of Management	5	08	01	½
2.	Organisation structure & organisational behaviour	10	21	02	1 ½
3	Production Management	10	13	01	01
4.	Materials Management	10	16	02	01
5.	Marketing ,Sales & Feasibility study	12	13	01	01
6.	Industrial legislation & safety	8	13	01	01
7.	Introduction to ISO 9000 & T.Q.M.	10	13	01	01
8	Role of Enterprenuer and Enterprenuerial Development	10	13	01	01
	Total	75	110	10	08

### OBJECTIVES

*On completion of the course the student will be able to*

- 1.0 Understand the principles of management as applied to industry.**
  - 1.1 Define industry, commerce (Trade) and business.
  - 1.2 Know the need for management.
  - 1.3 Understand the evolution of management
  - 1.4 Explain the principles of scientific management.
  - 1.5 Understand functions of Management.
  - 1.6 Differentiate between management and administration.
  
- 2.0 Know types of ownerships, the organisation structure of an industry and the behaviour of an individual in an organisation.**
  - 2.1 Understand types of ownerships
  - 2.2 Differentiate types of ownerships.
  - 2.3 Understand salient features of joint stock companies.

- 2.4 Understand the philosophy and need of organisation structure of an industry.
- 2.5 Understand the line, staff and Functional organisations.
- 2.6 List the advantages and limitations of line, staff and functional organisations.
- 2.7 List different departments in a large scale industry.
- 2.8 Explain the factors of effective organisation.
- 2.9 Understand organisational behaviour.
- 2.10 Conduct for analysis.
- 2.11 Assess the incurring applicants.
- 2.12 Outline the selection process.
- 2.13 Understand the sources of manpower.
- 2.14 State motivation theories.
- 2.15 State Maslow's Hierarchy of needs.
- 2.16 List out different leadership models.
- 2.17 Explain the trait theory of leadership.
- 2.18 Explain behavioural theory of Leadership.
- 2.19 Explain the process of decision Making.
- 2.20 Outline the communication process.

### **3.0 Understand the different aspects of production management.**

- 3.1 Differentiate and integrate production, planning and control.
- 3.2 Relate the production department with other departments.
- 3.3 State the need for planning and its advantages.
- 3.4 Explain the stages of Production, planning and control.
- 3.5 Explain routing methods.
- 3.6 Explain scheduling methods.
- 3.7 Explain dispatching.
- 3.8 Draw PERT/CPM networks.
- 3.9 Identify the critical path.

### **4.0 Understand the role of materials management industries.**

- 4.1 Explain the role of the materials in Industry.
- 4.2 Derive expression for inventory control.
- 4.3 Explain ABC analysis.
- 4.4 Define safety stock.
- 4.5 Define reorder level.
- 4.6 Derive an expression for economic ordering quantity.
- 4.7 Explain stock layout.
- 4.8 List out stores records.
- 4.9 Explain the Bin card.
- 4.10 Describe Cardex method.
- 4.11 Explain purchasing procedures.
- 4.12 List out purchase records.
- 4.13 Describe the stores equipment

## **5.0 Understand marketing, sales and feasibility study.**

- 5.1 Explain marketing functions.
- 5.2 Explain Sales function.
- 5.3 List out market conditions.
- 5.4 Differentiate Sellers and Buyers' market.
- 5.5 Differentiate monopoly, oligarchy, and perfect competition.
- 5.6 Conduct market and demand surveys.
- 5.7 Differentiate product and production analysis.
- 5.8 Identify the input materials, i.e. Bill of materials
- 5.9 Explain the concept of cost.
- 5.10 List out the elements of cost.
- 5.11 Explain the concept of contribution.
- 5.12 Explain break-even analysis.
- 5.13 Define the main policy requirements.
- 5.14 Decide the location.
- 5.15 Evaluate Economic and Technical factors.
- 5.16 Preparation of feasibility study.
- 5.17 List out different products currently in demand with market or industry.

## **6.0 Comprehend the provisions of industrial legislation in India. & Safety procedures**

- 6.1 Describe employer and employee relations.
- 6.2 Describe the mechanics of Trade Unions.
- 6.3 Describe mechanics of settlement of in outs.
- 6.4 Explain the significance of collective bargain.
- 6.5 List out Welfare activities.
- 6.6 List out subsidy schemes.
- 6.7 Explain the total welfare concept.
- 6.8 List out the rights and responsibilities of employees and employers.
- 6.9 List out the salient features of Indian Factories Act.
- 6.10 Explain the importance of safety at Work place.
- 6.11 List out the important provisions related to safety.
- 6.12 Explain the significance and mechanics of safety education.
- 6.13 Explain hazard and accident.
- 6.14 List out different hazards in the Industry.
- 6.15 Explain the causes of accidents.
- 6.16 Explain the direct and indirect cost of accidents.
- 6.17 List out provisions of Indian Electricity Rules laid in the electricity act1923.

## **7.0 Understand ISO 9000 & TQM.**

- 7.1 Understand the concept of quality.
- 7.2 Know the quality systems and elements of quality systems.
- 7.3 Know the principles of quality Assurance.
- 7.4 Know the Indian Standards on quality systems.
- 7.5 Know the evolution of ISO standards.
- 7.6 Discuss ISO standards and ISO 9000 series of quality systems.
- 7.7 State the constituents of ISO 9000 series of standards for quality systems.
- 7.8 State the outstanding features and drawbacks of ISO 9000 series of standards.
- 7.9 List the beneficiaries of ISO 9000.
- 7.10 Understand 5-S principles and ZERO DEFECT.

## **8.0 Understand the role of entrepreneur in economic development and in improving the quality of life.**

- 8.1 Outline the concepts of Entrepreneurship.
- 8.2 Define the word entrepreneur.
- 8.3 Determine the role of Entrepreneurship.
- 8.4 Describe the profile of an entrepreneur.
- 8.5 Explain the requirements of an entrepreneur.
- 8.6 Outline the expectations of Entrepreneurship.
- 8.7 Determine the role of entrepreneurs in promoting Small Scale Industries.
- 8.8 Describe the details of self-employment schemes.
- 8.9 Explain the method of product selection.
- 8.10 Explain the method of site selection.
- 8.11 Outline the method of plant layout.
- 8.12 List the financial assistance programmes.
- 8.13 List out the organisations that help an entrepreneur.

## **COURSE CONTENTS**

### **1. Principles and functions of management.**

Definitions of Industry, Commerce and Business. Evolution of management theories. Principles of Scientific Management, functions of management. Difference of administration and management.

### **2. Organisation Structure & organisational behaviour.**

Role of industry, Types of ownership – Sole proprietorship, Partnership, Private limited, Public limited company, Industrial Cooperatives, Philosophy, types of Organisations, Line and Staff and functional organisations. Advantages and limitations, departments in a large scale industry. Effective organisation. Job analysis, Assessing applicants, selection, motivation, different theories, Leadership in organisation, decision making, communication,

### **3. Production Management.**

Production, planning and control, relation with other departments, need for planning and its advantages, Routing, scheduling, despatching, PERT and CPM, simple problems.

### **4. Materials Management.**

Materials in industry, inventory control model, ABC Analysis, Safety stock, re-order, level, Economic ordering quantity, Stores layout, stores equipment, Stores records, purchasing procedures, purchase records, Bin card, Cardex.

### **5. Marketing, Sales & Feasibility Study**

Sellers and Buyers markets, Marketing, Sales, Market conditions, monopoly, oligarchy, perfect competition, Pricing Policies. Cost Elements of Cost, Contribution, Break even analysis, Market Survey, Product and production Analysis, Materials input, Manpower, Location, Economic and Technical Evaluation, preparation of Feasibility study reports, - different products – Mechanical, Electrical, Electronics, consumer items, Consumer desires etc.

### **6. Industrial Legislation & safety.**

Employer – Employee relations, Trade, Union Settlement of disputes, collective bargaining, Welfare activities, subsidies, Total Welfare concept, rights and responsibilities and Employers and employees. Salient features of Indian Factories Act, Important of Safety at work places, factories Act- Provisions,

Safety Education, Hazards, causes of accidents, Cost of accidents, Indian Electricity rules.

#### **7. Introduction to ISO 9000 and TQM.**

Concept of quality discussed by B. Crosby W. Edward, Deming, Joseph M. Jura Kooru Ishikawa, Genichi Taguchi, Shigco Shingo.

Quality systems – Definitions of the terms used in quality systems like, quality policy, quality management, quality systems, quality control and quality assurance.

Elements quality systems : Management responsibility, Quality system, contract review, design control, document control, purchasing, purchaser – supplied product, product identification and traceability, process control, Inspection and testing.

Principles of quality assurance – Definition of quality assurance.

Indian standards on quality systems – Main features of IS 13999 : 1990, IS 14000 : 1990, IS 14004 : 1990, IS 14001: 1990, IS 14002 : 1990, IS 14003: 1990.

Know the necessity of International standards – Evolution of ISO. **5-S** principles – importance – meaning – approach – benefits

Various standards under ISO – Outstanding features of ISO 9000 series of standards – ISO 9000 Phenomenon ISO 9000 series of quality systems – Constituents of ISO 9000 series of standards for quality systems.

Drawbacks of ISO 9000 series of standards, list the beneficiaries of ISO 9000 (Whom does ISO 9000 help).

#### **8. Role of Entrepreneur & Entrepreneurial Development.**

Concept, definition, role, expectation, entrepreneurship Vs Management, promotion of S.S.I. Self – employment schemes. Product selection, site selection, plant layout, profile and requirement, Institutional support needed, financial assistance programmes.

### **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. S.S.I Hand Book by S.B.P. Publishers.
5. Personnel Management by Flippo.
6. Entrepreneurship – by NITTT&R, Chennai.

## INDUSTRIAL ENGINEERING & ESTIMATING AND COSTING

Subject Title : Industrial Engineering & Estimating and Costing  
Subject Code : M-603  
Periods/Week : 05

Periods per Semester : 75

### TIME SCHEDULE

Sno.	Major Topics	No. of Periods	Weight age of Marks	Short Answer Questions	Essay Type Questions
1.	<b>Work Study</b>				
	a) Method Study	15	13	1	1
	b) Work Measurement	10	13	1	1
2.	Inspection & S.Q.C.	20	16	2	1
3.	Fundamentals of estimation	05	13	1	1
4.	Elements of costing	05	13	1	1
5	Estimation of Weights	05	13	1	1
6	Estimation of Machining times	05	13	1	1
7	Estimation of Fabrication costs	05	13	1	1
8	Estimation of Forging & Foundry costs	05	03	1	-
<b>Total</b>		<b>75</b>	<b>110</b>	<b>10</b>	<b>08</b>

### OBJECTIVES

On completion of the subject the student should be able to

- 1. Understand the principle of work study.**
  - 1.1. Apply method study to a given situation.
  - 1.2. State the steps involved in method study.
  - 1.3. Identify the elements of chart used in method study.
  - 1.4. Assemble the elements with symbols to form the required chart.
  - 1.5. State the purpose of work Measurement.
  - 1.6. Describe the time – study Equipment.
  - 1.7. Describe the sequence of making Time – study.
  - 1.8. State the rules for elemental Break down
  - 1.9. State the procedure of recording the Time.
  - 1.10. Explain the need for rating factor.
  - 1.11. Compute normal time.
  - 1.12. Explain the importance of Allowances.
  - 1.13. Compute the standard time for an operation using observed time.
  - 1.14. State the advantages of PMTS (Predetermined Motion Time Standards).
  - 1.15. State the purpose of work – sampling.
  - 1.16. State the advantages of work – sampling.
- 2. Understand inspection procedures & the quality control functions.**
  - 2.1. Distinguish between the terms quality of design and quality of Manufacturing.



- 2.2. Discuss quality – cost relationship.
- 2.3. Discuss quality variation parameters.
- 2.4. Know inspection procedures.
- 2.5. State the different inspection methods.
- 2.6. State the characteristics of normal distribution.
- 2.7. Construct control charts for variables and attributes.
- 2.8. Interpret control chart for “process in control” or “process out of control”.
- 2.9. Identify the situation where Random Sampling is useful.

### **3. Understand the fundamentals of estimation.**

- 3.1. Estimation of design time.
- 3.2. Estimation of drafting time.
- 3.3. Estimation of planning and production.
- 3.4. Estimate procurement or manufacturing time for special tools or equivalent.
- 3.5. Estimating labour, material and overhead costs.
- 3.6. Estimate selling expenses.
- 3.7. Estimate the selling price.

### **4. List out the elements of costing.**

- 4.1. List – out the elements of costing such as Direct material, direct labour and overhead expenses.  
Appraise the terms prime cost, factory cost, total cost overheads and depreciation.
- 4.2. Determine the items that go into Prime cost.
- 4.3. Determine the items that constitute on costs.
- 4.4. Calculate the cost of a product taking into consideration all the items.
- 4.5. Calculate the selling price of a Product.

### **5. Estimate the weight of material required for a product**

- 5.1. Divide the component drawing into simple and smaller geometrical configurations.
- 5.2. Calculate the volumes and the weight of the material required.
- 5.3. Estimate the cost of material.
- 5.4. Solve simple problems on the above.

### **6. Estimation of machining times**

- 6.1. Estimate time required for machining like turning, drilling, screw cutting
- 6.2. Solve problems on the above.

### **7. Estimate the fabrication cost.**

- 7.1. Use table for obtaining consumption of gas, filler rods, and rate of welding for different types of welding.
- 7.2. Estimate the cost of fabrication.

### **8. Estimate forging and foundry costs**

- 8.1. Estimate the loss in forging.
- 8.2. Define the terms net and gross weight.
- 8.3. Know the components that go into foundry costs

## **COURSE CONTENTS**

### ***Contribution of work study to productivity***

#### **1. Work Study.**

- 1.1. Meaning and purpose.
- 1.2. Components of Work study – Method study & Time study
- 1.3. Method study- purpose
- 1.4. Method study -procedure
- 1.5. Process chart symbols-types
- 1.6. Outline process chart -illustration
- 1.7. Flow process chart - illustration
- 1.8. Flow diagrams-illustration

- 1.9. String diagram -illustration
- 1.10. Two handed process chart-illustration
- 1.11. Micro motion study- concept
- 1.12. Principles of Motion economy
- 1.13. Therbligs
- 1.14. SIMO Chart
- 1.15. Cycle graph -Chronocyclegraph
- 1.16. Time study -purpose.
- 1.17. Stop watch study - procedure
- 1.18. Performance rating –concept
- 1.19. Rating scales
- 1.20. Time allowances
- 1.21. Determination of Normal Time & standard time.
- 1.22. simple problems on Normal and standard times
- 1.23. PMTS-necessity - advantages
- 1.24. Work sampling-concept – advantages
- 1.25. Simple problems on Work sampling
- 2. Inspection and Statistical quality control**
  - 2.1. Quality-quality of design-quality conformance-quality assurance
  - 2.2. Quality -cost relationship,
  - 2.3. Inspection – objectives of inspection
  - 2.4. Methods of inspection
  - 2.5. Quality control-necessity
  - 2.6. variation in manufacture-assignable causes - chance causes
  - 2.7. Quality characteristics-variables-attributes
  - 2.8. Normal curve-properties of normal curve.
  - 2.9. Simple problems on Normal curve applications
  - 2.10. Control charts – necessity - types
  - 2.11. X and R charts – concept
  - 2.12. Method of constructing X-R chart-simple problems
  - 2.13. Control chart for attributes – advantages
  - 2.14. Method of constructing – fraction defective and no. of defectives charts-simple problems
  - 2.15. Terminology of sampling inspection
  - 2.16. OC curve – illustration-importance
  - 2.17. Single sampling plan – illustration
  - 2.18. Double sampling plan - illustration
  - 2.19. A B C standards – use of tables
  - 2.20. Acceptance criteria for single and double sampling plans using tables-simple problems
- 3. Fundamentals of estimating**
  - 3.1. Meaning of Estimation – necessity
  - 3.2. Meaning of costing - necessity
  - 3.3. Difference between estimation and costing
  - 3.4. Principle constituents of estimating the cost of a component
  - 3.5. Meaning of design time, drafting time, planning time, production time, labour, materials, overheads
- 4. Elements of costing.**
  - 4.1. Elements of cost - material, labour and expenses
  - 4.2. Classification of cost - direct material, direct labour and overhead s
  - 4.3. Definition of Prime cost, factory cost, production cost ,total cost and selling price
  - 4.4. Calculation of the selling price of a product – simple problems

4.5. Depreciation-sinking fund method- simple problems.

**5. Estimation of weights of materials**

5.1. Review of mensuration formulae for regular 2D figures including fillets, segments of circles

5.2. Review of mensuration formulae for regular 3D solids including solids of revolutions and segments

5.3. Principles of dividing the component drawing into simple and smaller geometrical configurations.

5.4. Table showing the specific weights of important engineering materials

5.5. Simple problems on estimation of weights of machine components.

**6. Estimation of Machining times**

6.1. Meaning of cutting speed – feed – depth of cut- machining time-purpose of calculating machining time

6.2. Formulae for all basic turning times

6.3. Simple problems on estimation of turning times

6.4. Formulae for Drilling – screw cutting times

6.5. Simple problems on combination of turning, drilling, screw cutting times

**7. Estimation of fabrication cost.**

7.1. Oxy-acetylene gas welding – principle – rightward and leftward techniques

7.2. Estimation of gas welding time using tables

7.3. Simple problems on estimation of gas welding times

7.4. Estimation of arc welding costs-components that go into cost

7.5. Simple problems on estimation of arc welding costs

**8. Estimation of forging and foundry costs.**

8.1. Components that go into forging costs

8.2. Forging loses – net weight – gross weight

8.3. Patten allowances used in Foundry – net weight – gross weight

8.4. Components that go into foundry costs

8.5. Simple problems on calculation of forging loses given net weight.

**REFERENCE BOOKS**

Work study – by Ralph Banes.

Work study – by I.L.O.

S.Q.C – by Grant & Levenworth

S.Q.C -by Juran

Industrial Engineering & Management Science. - by T.R.Banga

Estimating & Costing - by Agarwal.

Estimating & costing -by Narang & Acharya

Estimating & Costing -by T.R. Banga – Sharma.

## CAD/CAM

**Subject Title** : **CAD / CAM**

**Subject Code** : **M – 604**

**Periods per week** : **05**

**Period per semester** : **75**

### TIME SCHEDULE

SI No.	Major Topics	No. of periods	WEIGHTAGE	SHORT	ESSAY
1.	Computer Aided Design and Manufacturing	20	29	3	2
2.	CNC Machines and their components	20	29	3	2
3.	CNC Part Programming	20	26	2	2
4.	CIMS & Flexible Manufacturing Systems	10	16	2	1
5.	Robotics	05	10	0	1
	TOTAL	75	110	10	08

**OBJECTIVES** *On completion of the course the student should be able to*

#### 1. Computer Aided Design and Manufacturing

- 1.1. Define CAD
- 1.2. Identify advantages of CAD
- 1.3. Identify CAD software and hardware
- 1.4. Appreciate importance of Auto CAD as a CAD software
- 1.5. Familiarize with Graphic Work Station.
- 1.6. Define CAM
- 1.7. Identify the functions of CAM
- 1.8. Appreciate the advantages of CAM
- 1.9. Familiarize with the term computer integrated production system
- 1.10. Familiarize with the terms material requirement planning (MRP I) and manufacturing resources planning (MRP II)

#### 2. CNC Machines and their Components

- 2.1. Define numerical control
- 2.2. Identify the components of NC & CNC systems
- 2.3. Differentiate between NC, CNC & DNC systems
- 2.4. Manufacturing Methodology on NC system
- 2.5. Illustrate the working principle of CNC system
- 2.6. Familiarize with the term Machining Centre
- 2.7. Identify the maintenance aspects of CNC machines
- 2.8. Appreciate the role of CNC in computer integrated manufacturing environment
- 2.9. Identify the various spindle drives

- 2.10. Illustrate slide ways
- 2.11. Familiarize with linear motion bearings, recirculatory ball screws
- 2.12. Appreciate the importance of automatic tool change
- 2.13. Illustrate tool magazine
- 2.14. Identify the various feed back devices

### **3. CNC PART PROGRAMMING**

- 3.1. Familiarize with structure of NC part program
- 3.2. Differentiate between manual and computer aided programming methods
- 3.3. Familiarize with G & M codes
- 3.4. Know the method of programming tool information, feed, speed data
- 3.5. Identify the various programming cycles like thread cutting cycle etc.
- 3.6. Write a part program in G & M codes for a simple turning job
- 3.7. Appreciate the importance of macros, sub routines, canned cycles, mirror image
- 3.8. Appreciate the necessity of tool nose radius compensation in programming
- 3.9. Familiarize with APT programming

### **4. CIMS & FMS**

- 4.1. Define CIMS
- 4.2. Appreciate the necessity of CIMS
- 4.3. Appreciate the advantages of CIMS
- 4.4. Identify FMS as a sub set of CIMS
- 4.5. Identify the components of FMS
- 4.6. Illustrate the working of FMS
- 4.7. Identify the benefits of FMS
- 4.8. Appreciate the importance of coordinate measuring machine.
- 4.9. Illustrate the main features of CNC-CMM
- 4.10. Advantages of CNC-CMM

### **5. ROBOTICS**

- 5.1. Define a robot
- 5.2. Classify robots
- 5.3. Identify the various elements of a robot
- 5.4. Illustrate the working of a manipulator
- 5.5. Illustrate the types of end effectors
- 5.6. Identify the applications of robots
- 5.7. Appreciate the role of robots in CIMS

## **COURSE CONTENTS**

### **1. COMPUTER AIDED DESIGN AND MANUFACTURING**

- 1.1. Introduction to CAD
- 1.2. Benefits of CAD
- 1.3. Stages of CAD
- 1.4. CAD input out put devices
- 1.5. CAD Output devices
- 1.6. CAD display devices
- 1.7. Types of CAD systems
- 1.8. Types of CAD soft ware
- 1.9. Features of different CAD software
- 1.10. Computer communications
- 1.11. Types of computer communications networks

- 1.12. Introduction to CAM
- 1.13. Functions of CAM
- 1.14. Benefits of CAM
- 1.15. Integrated CAD / CAM Organization – concept
- 1.16. Necessity of CAD/CAM integration
- 1.17. Computer integrated production system – features
- 1.18. Computer integrated production system -advantages
- 1.19. Introductory treatment to MRP I
- 1.20. Introductory treatment to MRP-II

## **2. CNC MACHINES AND THEIR COMPONENTS**

- 2.1. Introduction to numerical control
- 2.2. Features of NC system
- 2.3. Advantages of NC system
- 2.4. Limitations of NC system in comparison to conventional systems
- 2.5. Layout of NC system
- 2.6. Functions of each component of NC system
- 2.7. Manufacturing methodology on NC system
- 2.8. Development of CNC and DNC systems
- 2.9. comparative treatment of features for NC, CNC, DNC
- 2.10. Block diagram of CNC system
- 2.11. Functions of each component of a CNC system
- 2.12. Working principle of CNC system – advantages over NC system
- 2.13. Machining centers -Types
- 2.14. Specifications of CNC machines.
- 2.15. Care and maintenance of CNC machines
- 2.16. Spindle drives – DC drive – AC drive and linear induction motors
- 2.17. Slide ways – types with illustrations
- 2.18. Bearings – linear motion bearings – recirculatory ball screws
- 2.19. Automatic tool change – working of tool magazine
- 2.20. Feed back devices – encoders – linear transducers'

## **3. CNC PART PROGRAMMING**

- 3.1. Steps involved in CNC part programming
- 3.2. CNC coordinate system
- 3.3. zero points-types
- 3.4. Co-ordinates referencing methods
- 3.5. Preparatory functions (G codes)
- 3.6. Miscellaneous functions (M codes)
- 3.7. Manual part programming -format
- 3.8. APT programming
- 3.9. Tool nose radius compensation
- 3.10. linear interpolation-coding
- 3.11. Circular interpolation methods-coding
- 3.12. Macros
- 3.13. subroutines
- 3.14. mirror image
- 3.15. Thread cutting cycles
- 3.16. Taper turning cycles
- 3.17. Peck drilling cycles
- 3.18. Programming Practice problems on Plain turning
- 3.19. Programming Practice problems on Step turning

### 3.20. Programming Practice problems on Taper turning

#### **4. CIMS & FLEXIBLE MANUFACTURING SYSTEMS**

- 4.1. Computer integrated manufacturing system – features
- 4.2. Necessity of CIMS
- 4.3. Flexible manufacturing system – features
- 4.4. Necessity of FMS
- 4.5. Components of FMS –illustration
- 4.6. Functions of each component
- 4.7. Advantages and limitations of FMS
- 4.8. Introduction to CMM
- 4.9. CNC CMM – features
- 4.10. Advantages of CNC-CMM

#### **5. ROBOTICS**

- 5.1. Definition of robot – classification – features – necessity
- 5.2. Components of robot – illustration – functions of each component
- 5.3. Manipulator – illustration – degrees of freedom
- 5.4. End effectors - types with illustration – necessity and application
- 5.5. Industrial application of robots – advantages and limitations

#### **REFERENCE BOOKS :**

1. Computer Integrated Design And Manufacturing, McGraw Hill – Bedworth David. D
2. Computer Integrated Manufacturing, PHI – Paul G. Ranky
3. Industrial Robotics, PHI – Gordon. N. Mair
4. Computer Aided Manufacturing, TMH – T. K. Kundra, P.N. Rao
5. CNC Machines, New Age – B.S. Pabla and M. Adithan
6. CAD, CAM, CIM ----- BY Radha Krishnan.

## DESIGN OF MACHINE ELEMENTS

Subject Title	:	Design of Machine Elements
Subject Code	:	M – 605
Periods/Week	:	05
Periods/Semester	:	75

### TIME SCHEDULE

S. No	Major Topics	Periods	Weightage of Marks	Short Answer Questions	Essay Type Questions
1	Introduction	05	08	01	$\frac{1}{2}$
2	Bolts, Nuts & Screws	12	21	02	1 $\frac{1}{2}$
3	Shafts, Keys & Couplings	17	26	02	02
4	Belts, chain drives & Gears	25	36	02	03
5	Cams	12	13	01	01
6	Fly wheels & Governors	04	06	02	--
<b>Total</b>		<b>75</b>	<b>110</b>	<b>10</b>	<b>08</b>

### OBJECTIVES

*On completion of the study of the subject a student should be able to comprehend the following*

#### 1. Introduction

- 1.1. To understand the basic requirements of design.
- 1.2. To define the term design.
- 1.3. To identify the factors governing design.
- 1.4. To state general design procedure.
- 1.5. To use relevant Indian Standard Codes.

#### 2. Bolts, Nuts and Screws.

- 2.1 To appreciate the theory of strength calculations.
- 2.2 Design the size of bolt for a given load requirement.
- 2.3 To make a proportionate sketch.

#### 3. Shafts, Keys and Couplings

- 3.1 Understand the design of shafts, keys and couplings under permissible conditions of strength and rigidity.
- 3.2 State the types and functions of shafts.
- 3.3 Design solid and hollow shafts to transmit a given power a given RPM, under permissible conditions of shear stress combined bending and torsion, angle of twist and deflection.
- 3.4 Design an axle.
- 3.5 Know standard sizes of shafts as per I.S.
- 3.6 Explain the function of keys and splines.
- 3.7 Name the recommended materials used for keys and splines.
- 3.8 Explain the possible ways of failure of a key under load.



- 3.9 Design and sketch a rectangular sunk key considering failure against shear and crushing for a given torque and also using empirical relations.
- 3.10 Write all the proportions of a spline for a given application referring tables.
- 3.11 Know the specifications of parallel, gib-head and taper sunk keys as per B.I.S.
- 3.12 Explain the function of a coupling.
- 3.13 Calculate various dimensions of muff coupling for a shaft of given size using empirical relations and sketch.
- 3.14 Design a cast iron flange-coupling (rigid type) for a given torque.

#### **4. Belts, chains and gears.**

- 4.1 To know the selection criteria of various means of power transmission.
- 4.2 To identify various types of belts.
- 4.3 To identify different types of drives in belts.
- 4.4 To design a stepped pulley for a belt drive.
- 4.5 To compute power transmitted.
- 4.6 To design belt dimensions for a given power transmission.
- 4.7 To apply the effect of centrifugal tension in the above cases.
- 4.8 To explain & state advantages of rope/chain drives.
- 4.9 To explain the nomenclature of spur gear tooth.
- 4.10 Write-down empirical values for addendum etc., in terms of module.
- 4.11 To identify various tooth profiles of gear.
- 4.12 To state the applications of different types of gears.
- 4.13 To state Lewi's formula for tooth load.
- 4.14 To apply design calculation of straight spur gears.

#### **5. Cams.**

- 5.1 To understand the features of cam profile.
- 5.2 To classify the cams.
- 5.3 To define terms related to cam profile.
- 5.4 To draw angular - displacement diagram for lift motion for:
  - a) Uniform velocity.
  - b) S.H.M.
  - c) Uniform acceleration & retardation.
- 5.5 To draw simple cam profiles in above three cases for a knife edged, flat and roller followers.

#### **6. Fly wheels and Governors**

- 6.1 State the function of flywheel.
- 6.2 Explain the terms related to flywheel.
- 6.3 State the formula for energy store by flywheel(problems omitted).
- 6.4 To know the function of governor
- 6.5 To understand the differences between function of governor and flywheel.
- 6.6 Write the classification of governors.
- 6.7 Description of Watt Governor & Porter Governor
- 6.8 To explain terms – sensitiveness, stability, isochronism, hunting, effort and power of governor.(problems omitted)

## COURSE CONTENTS

### 1. Introduction

Factors governing the design of machine element, nature of load, working stress, mechanical properties of the material of the product, process of manufacture, reliability, durability.

Cost, life of product and safety, general sequence of steps in designing a machine or element.

Need of standard data for design purpose, use of machine design data, hand books and other data manuals.

### 2. Bolts, Nuts and Screws

Revision of nomenclature, form of threads – specifications.

Thread, bolt and nut – Nature of loads and failures to which a bolt can be subjected to initial stresses due to tightening - stresses due to external forces - stress due to combination of forces – Stresses due to shear loads application.

Design of Nut – Hexagonal and square shapes only.

Calculation & sketching bolt & nut using empirical proportions.

Design of eye bolt for a given load and sketching - using empirical proportions, applications of eye-bolt.

### 3. Shafts, Keys and Couplings

Function of shafts and materials used for them.

Design of diameters for solid and hollow shafts to transmit a given power at given rpm., under

- a) Given permissible conditions of strength.
  - i) Shear stress.
  - ii) Combined bending and torsion.
- b) Given permissible conditions of rigidity.
  - i) Angle of twist.
  - ii) Deflection.
  - i) Modulus of rigidity.

Design of axle.

Standard sizes of shafts as per I.S.

Numerical problems

Function of keys and splines specification of splines.

Materials of keys and splines.

Discussion over nature of failure of key-effect of key way and the shaft strength.

Design of a rectangular sunk key considering its failure against shear and crushing – Given the power transmitted by the shaft and rpm.

Design of rectangular sunk key using empirical proportions for given diameter of the shaft. Check for strength.

Proportions for a spline for a given application using tables.

Couplings : Function of coupling & types of couplings.

Calculation of proportions of a muff coupling (solid) for a given shaft size using empirical formulae, sketching the same from the computed dimensions.

Rigid flange coupling : Calculation of dimensions for a C.I. flange coupling and coupling bolts for a given torque using empirical proportions – Sketching the flange coupling with the computed dimensions.

Numerical problems and sketching.

#### **4. Belts, chains and Gears**

Belt drive, types of drives length of the open and crossed belts (without proof).

Design of stepped pulley belt drive only. Expression for the ratio of driving tensions (without proof).

Concept of centrifugal tension – Relation between centrifugal tension and the tension on tight side for transmitting maximum power (derivation omitted).

Permissible stress in the belt per unit width : per unit cross section.

Calculation of belt thickness and width for given permissible stress for open and crossed belts, considering centrifugal tension and without it.

Chain drives – Types of chains – Roller and silent chains.

Numerical problems.

Gear teeth terminology – Pitch diameter – Circular pitch and module of gear wheel.

Simple, compound reverted & Epi cyclic gear trains.

Design for number of teeth for simple, compound and reverted gear train for a given speed rating and sketching the arrangement.

Selection of gear wheels to cut threads for a given pitch on a lathe.

Problems on screw cutting on lathe – Back gear assembly 3 – Speed gear box of an automobile.

Description and application of epicyclic gear trains (Problems not included)

#### **5. Cams**

Classification of cams and followers – uses.

Working principle of plate and cylindrical cams.

Nomenclature of radial cam.

Explanations of terms cam profile, base-circle, cam angles, trace point.

Motion follower – Uniform velocity, uniform acceleration and retardation and simple harmonic motion – Time Vs. displacement diagram only.

Construction of cam profile of a plate cam with knife edged, flat & roller follower for all three types of motions stated above.

Problems on drawing of cam profiles as stated above for the follower axis passes through the axe of the cam shaft.

#### **6 Fly wheels and Governors**

Purpose and applications – Calculation of size of flywheel given turning moment diagram, power developed by engine. Flywheel for punching operations.

Governor--its function –types:(A) Centrifugal governor- Simple Watt governor, Porter governor—(B) Inertia governor. Sensitiveness, Stability, Isochronism, Hunting, Effort and power of governor and simple problems.

#### **REFERENCES**

1. Design of Machine Elements - Abdulla Shariff.
2. Machine Design - R.S.Khurmi.
3. Design of Machine Elements - Pandya and Shah.
4. Theory of machines- Thomas Bevan.

## REFRIGERATION AND AIR CONDITIONING

<b>Subject Title</b>	:	<b>Refrigeration and Air conditioning</b>
<b>Subject Code</b>	:	<b>M-606(A)</b>
<b>Periods/Week</b>	:	<b>05</b>
<b><i>Periods per Semester</i></b>	:	<b>75</b>

### TIME SCHEDULE

Sl. No.	Major Topics	No. of Periods	Weightage	Short Answer questions	Essay Type Questions
1.	Fundamentals of Refrigeration & Air Refrigeration	10	16	2	1
2.	Vapour compression & Vapour absorption Refrigeration Systems	20	29	3	2
3.	Refrigerants, Refrigeration equipment & Applications	20	29	3	2
4.	Fundamentals of A/c & A/c Equipment	10	13	1	1
5.	Psychrometry,	10	13	1	1
6.	Applications of Air Conditioning	05	10	-	1
<b>Total</b>		<b>75</b>	<b>110</b>	<b>10</b>	<b>08</b>

**OBJECTIVES:** On completion of the course the student should be able to

**1.0 Understand the various methods of Refrigeration.**

1.1 Define refrigeration.

Know the history of refrigeration.

Know principles involved in different methods of refrigeration such as ice, dry, ice, steam jet water refrigeration, liquid nitrogen refrigeration.

Express unit of refrigeration in Terms of ton of refrigeration.

Define coefficient of Performance.

Evaluate power required per ton of refrigeration.

1.7 Know the principle of open air refrigeration.

1.8 Analyse carnot refrigeration Cycle.

1.9 Analyse Bell-Colomen air-cycle.

1.10 Know principle of closed air Refrigeration.

1.11 Compare open air system with closed air system.

## **2.0 Understand Vapour Compression, and Vapour absorption Refrigeration Systems.**

- 2.1 Know the importance of vapour compression system.
- 2.2 Analyse vapour compression refrigeration with the help of T-S and P-H diagrams.
- 2.3 Distinguish wet and dry compression.
- 2.4 Know the effects of under cooling and super heating and effect of pressure changes on COP.
- 2.5 Know the use of flash chamber and accumulator.
- 2.6 Calculate COP of plant working on vapour compression system.
- 2.7 Know the principle of simple vapour absorption systems.
- 2.8 Identify refrigerant – Absorber pairs in the above system.
- 2.9 State the desirable properties of refrigerants absorbers.
- 2.10 Describe the working principle of continuous absorption system.
- 2.11 Calculate “COP” of the ideal vapour absorption system.
- 2.12 Differentiate two fluid system and three fluid absorption system.
- 2.13 Illustrate the working of electrolux refrigeration.
- 2.14 Illustrate the working of Lithium Bromide absorption refrigeration system.

## **3.0 Know the Refrigerants, Refrigeration Equipment and applications of Refrigeration**

- 3.1 Distinguish between primary and secondary refrigerants.
- 3.2 Identify the requirements of Refrigerants.
- 3.3 Know the properties of refrigerants.
- 3.4 Identify the commonly used refrigerants.
- 3.5 Illustrate different types of compressors such as reciprocating and rotary types.
- 3.6 Know the function of condenser.
- 3.7 Illustrate different types of condensers such as shell & tube, shell and coil, fin and tube, flooded tube type.
- 3.8 Illustrate various types of evaporators such as shell & tube, shell and coil, fin and tube, flooded tube type.
- 3.9 Illustrate the functions of various types of expansion devices such as capillary tube, thermostatic expansion valves and solenoid valves.
- 3.10 Illustrate the refill type and throw away type dryers.
- 3.11 Illustrate the working of domestic refrigerator.
- 3.12 Illustrate the working of ice Plant.
- 3.13 Illustrate the working of water cooler.
- 3.14 Illustrate the working of cold storage.
- 3.15 Explain the production of dry ice.

## **4.0 Understand fundamentals of A/c and A/c equipment**

- 4.1 Define air conditioning.
- 4.2 Identify modern application of A/c.
- 4.3 Explain A/c as applied to human comfort.
- 4.4 Illustrate the functions of fans, ducts, filters (wet, dry, electric & viscous types) C.F dust collector.
- 4.5 Illustrate the use of heating and cooling coils.
- 4.6 Explain the air distribution system.

## **5.0 Understand Psychrometry.**

- 5.1 Define the terms humidity, Relative humidity, dew point, DBT & WBT, Absolute humidity, humidity ratio.

- 5.2 Explain the features of psychrometric chart.
- 5.3 Plot psychrometric processes on the above chart.
- 5.4 Explain the psychrometric patterns for heating and cooling processes.

**6.0 Appreciate the applications of A/C.**

- 6.1 Illustrate the working of air coolers.
- 6.2 Illustrate the working of window air – conditioner.
- 6.3 Illustrate the working of cooling tower installations.
- 6.4 Illustrate the working of A/c systems viz., centralised and unitary systems.
- 6.5 Illustrate the working of summer/winter/year round air conditioners.

## REFRIGERATION

### COURSE CONTENTS

**1.0 Fundamentals of Refrigeration and Air Refrigeration**

Introduction – Definition and meaning of refrigeration, methods of refrigeration – unit of refrigeration – COP.

Thermodynamic analysis of Refrigeration cycles, Carnot refrigeration cycle – Air refrigeration cycle (Bell – Coloman) open air and closed air systems of refrigeration( problems omitted ).

**2.0 Vapour Compression and absorption Refrigeration Systems.**

Principle & analysis of vapour compression refrigeration system with the help of T-S & P-H diagrams – wet, dry and superheated compression – Refrigerating effect – Effect of pressure changes on C.O.P., effect of sub – cooling of condense on COP and capacity – effect of super heating of vapour before compression – flash chamber and accumulator.

Principle of vapour absorption refrigeration, C.O.P of vapour absorption system - Refrigerants and absorbents – their properties – two fluid & three fluid systems - electrolux refrigeration – comparison of vapour absorption and vapour compression systems.

**3.0 Refrigerants, Refrigeration Equipment and applications**

Primary and secondary refrigerants with examples – requirements of a refrigerant – properties of refrigerants – Commonly used refrigerants

Compressors – types of compressors.

Condensers – types of condensers.

Evaporators – types of evaporators.

Expansion devices – types of expansion devices – Refill type and throw away dryers.

Domestic refrigerators – ice plant, Water cooler – cold storages – production of dry ice.

## AIR CONDITIONING

### 4.0 Fundamentals of A/c and A/c equipment

Comfort air conditioning: Human comfort – effective temperature – Factors governing effective temperature conditions that effect body heat – comfort chart.

A/C Cycle equipment such as fans, supply ducts, outlets, return outlets and ducts, filters & dust collectors heating/cooling coil-Air distribution.

### 5.0 Psychrometry:

Psychrometry – Psychrometric terms – Psychrometric chart – Solving problems with psychrometric chart – Practical applications of psychrometric terms – Psychrometric processes. Psychrometric patterns for heating & cooling processes.

### 6.0 Applications of A/C: Air coolers – window air conditioner's – (split & package type ) – cooling towers – A/C systems: summer/winter/year round A/C, central A/C system – unitary system.

## REFERENCE BOOKS

1. Refrigeration and Air Conditioning – by Domakundavar
2. Refrigeration and Air Conditioning – by Arora
3. Refrigeration and Air Conditioning – by Sarao & Gabi
4. Refrigeration and Air Conditioning – by Dosatt
5. Refrigeration and Air Conditioning – by Stoecker

## **AUTOMOBILE ENGINEERING**

Subject Title : AUTOMOBILE ENGINEERING  
subject code : M-606(B)  
No. of periods/week : 05  
Periods/Semester : 75

### **TIME SCHEDULE**

<b>S.No</b>	<b>Major Topics</b>	<b>Number of Periods</b>	<b>Weightage of Marks</b>	<b>Short Answer Questions</b>	<b>Essay Type Questions</b>
1	Introduction & Chassis Construction	12	16	2	1
2	Transmission & Clutches	18	32	4	2
3	Propeller shaft and rearexle	14	18	1	1 ½
4	Suspension system	09	13	1	1
5	Front axle and steering	14	18	1	1 ½
6	Brakes	8	13	1	1
	<b>Total</b>	<b>75</b>	<b>110</b>	<b>10</b>	<b>08</b>

### **OBJECTIVES**

On the completion of the course the student should be able to

#### **1.0 Introduction & Chassis construction**

- 1.1 Identify various components of an automobile .
- 1.2 Explain the function of basic structure, power plant, transmission system, auxiliaries, controls of the automobiles.
- 1.3 Identify the various types of Chassis construction.
- 1.4 Explain conventional Chassis construction.
- 1.5 Explain Frame construction.
- 1.6 Identify the materials for frame
- 1.7 Defects in Frames.
- 1.8 Explain the frameless construction.



## **2.0 Transmission & Clutches**

- 2.1 Understand the term Transmission.
- 2.2 Functions of transmission system.
- 2.3 Concept of total resistance to the vehicle motion - tractive effort- Necessity of transmission.
- 2.4 Types of gear boxes.
- 2.5 Selector Mechanism.
- 2.6 Lubrication of gear box.
- 2.7 The environment (Requirements) for the effective functioning of Clutch.
- 2.8 Mechanical operation of clutch.
- 2.9 Identify the main types of clutches.
- 2.10 Principle of friction clutches.
- 2.11 Different types of dry friction clutches.
- 2.12 Hydraulically operated (Fluid type) clutch.
- 2.13 Components of clutch.

## **3.0 Propeller Shaft and rear axle.**

- 3.1 Identify the functions of propeller shaft.
- 3.2 Explain construction of propeller shaft.
- 3.3 Know about various universal joints in automobile
- 3.4 Functions and operation of a differential in an automobile.
- 3.5 Sketch general arrangement of a live rear axle
- 3.6 Identify loads on rear axle.
- 3.7 Identify different methods of supporting rear axle.
- 3.8 Know the difference between semi-Floating and fully floating rear axle.

## **4.0 Suspension System**

- 4.1 Objectives of vehicle suspension.
- 4.2 Identify various factors considered for suspension
- 4.3 Know about different types of suspension springs
- 4.4 Construction of leaf spring and its mounting on front and rear axles.
- 4.5 Different types of rubber springs.
- 4.6 Explain air suspension system with a diagram.
- 4.7 Explain the principle of shock absorber.
- 4.8 Explain the construction and working of a telescopic type of shock absorber.

## **5.0 Front Axle and Steering.**

- 5.1 Understand the terms Front Axle and Steering.
- 5.2 Stub Axle types.
- 5.3 Front wheel assembly
- 5.4 Factors of wheel alignment.
- 5.5 Balance of wheels-Inflation of tyres- Brake Adjustment.
- 5.6 Steering geometry
- 5.7 Steering linkages.
- 5.8 Correct Steering angle.
- 5.9 Steering mechanism
- 7.10 Cornering force – Self righting torque.
- 7.10 Under steering – over steering.

7.11 Principle of power steering.

## **6.0 Brakes**

- 6.1 Know the requirements of automobile brake.
- 6.2 Explain briefly the transfer of weight during braking operation.
- 6.3 Know about the wheel skidding and techniques to prevent wheel skidding.
- 6.4 Various factors influencing braking effect.
- 6.5 Classify the brakes.
- 6.6 Describe mechanical shoe brake.
- 6.7 Draw a simple diagram to show the layout of a hydraulically operated four wheel brake system and explain its working in detail.
- 6.8 Draw a schematic diagram showing the layout of complete air pressure system of brakes and explain the working of its main units in detail.

## **COURSE CONTENTS**

### **1.0 Introduction & Chassis construction**

- 1.1 identify the various components of an automobile.
- 1.2 To know briefly about the basic structure, the power plant, transmission system, the auxiliaries the controls and the superstructure of an Automobile.
- 1.3 Different types of Chassis construction.
- 1.4 Explain the functions of the Frame.
- 1.5 Explain the loads on the frame,
- 1.6 Describe frame construction with a neat sketch.
- 1.7 Identify the various materials for frame.
- 1.8 Briefly explain about subframes and defects in frames.
- 1.9 Explain the frameless construction with a sketch.

### **2.0 Transmission and Clutches**

- 2.1 Introduction
- 2.2 Functions of transmission system
- 2.3 Concept of total resistance to the vehicle motion – Tractive effort - necessity of transmission.
- 2.4 Working of Sliding mesh – Constant mesh – Synchromesh – gear box.
- 2.4 Working of selector mechanism with gear lever on top of transmission case.
- 2.6 lubrication of gear box.
- 2.7 Functions of clutches.
- 2.8 Requirements of Clutch.
- 2.9 Mechanical operation of clutch.
- 2.10 Main types of clutches like friction and fluid
- 2.11 Principle of friction clutches – coefficient of friction ( $\mu$ ), Axial Pressure ( $w$ ) and mean radius of contact surfaces ( $R$ )
- 2.12 Description and working of dry friction clutches – Single plate multi plate.

- 2.13 Working of Hydraulically operated single plate clutch.
- 2.14 Brief description of Components of clutch, clutch plate- clutch facing – pressure plate – Springs – Bearings.

### **3.0 Propeller Shaft and rear axle.**

- 3.1 State the functions of propeller shaft.
- 3.2 Explain the construction of propeller shaft with a neat sketch.
- 3.3 Describe various universal joints in automobiles.
- 3.4 Explain the function and operation of differential in an automobile.
- 3.5 Draw the general arrangement of a live rear axle.
- 3.6 Explain different loads on rear axle.
- 3.7 Explain different methods of supporting rear axle shafts with sketch.
- 3.8 Explain the difference between semi-floating and fully floating rear axle.

### **4.0 Suspension System**

- 4.1 State the objectives of vehicle suspension
- 4.2 Explain the factors to be considered for suspension system.
- 4.3 Different types of suspension springs.
- 4.4 Explain the construction of leaf spring and how it is mentioned on rear and front axles with neat sketch.
- 4.5 Explain different types of rubber springs.
- 4.6 Explain briefly the action of air springs
- 4.7 Draw the schematic diagram showing the layout of an air suspension system and describe the same.
- 4.8 Explain principle, construction and working of a telescope type of shock absorber.

### **5.0 Front Axle and Steering**

- 5.1 Introduction to front axle.
- 5.2 Stub axle connection- ELLIOT – Reversed ELLIOT – LAMOINE – Reversed LAMOINE – brief Description.
- 5.3 Description of front wheel stub axle assembly.
- 5.4 Factors influencing wheel alignment .
- 5.5 Factors pertaining to wheels – Balance of Wheels - Inflation of tyres – Brake adjustment-Concept of Steering, Geometry – Camber – Kingpin inclination – combined angle - castor – Toe-in & Toe-out.
- 5.6 Steering linkage – principle of correct steering angle (without mathematical analysis) simple equation
- 5.7 Details of Ackerman steering mechanism.
- 5.8 Concept of cornering force-self righting torque.
- 5.9 Concept of under steering & over steering.

### **6.0 Brakes**

- 6.1 State the requirements of a automobile brake.
- 6.2 Explain briefly the transfer of weight during braking operators.
- 6.3 Explain wheel skidding and describe techniques to prevent wheel skidding.
- 6.4 Describe various factors influencing braking effect.
- 6.5 Classification of brakes.
- 6.6 Explain mechanical shock brake with a neat sketch.
- 6.7 Show the layout of a hydraulically operated four wheel brake system with a simple diagram and explain its working in detail.

6.8 Draw a schematic diagram showing the layout of complete air processor system of brakes and explain the working of its main units in detail.

**REFERENCE BOOKS:**

1. The motor vehicle - Newton steeds. & Garret
2. Automotive Chassis - P.M. Heldt.
3. Mechanism of the car - A.W. Judge
4. Automotive mechanism - Joseph Heitner.
5. The Automobile - Harbansigh Reyat
6. Automotive Engineering - G.B.S. Narang
7. An introduction to Automobile Engineering - N.R. Khatawate

## ENERGY SOURCES AND POWER PLANT ENGINEERING

Subject Title	:	Energy Sources and Power Plant Engineering
Subject Code	:	M-606(C)
Periods/Week	:	05
Periods/Semester	:	75

### TIME SCHEDULE

S. No.	Major Topics	No. of Periods	Weight age of Marks	Short Answer Questions	Essay Type Questions
1	Introduction of Renewable Sources of Energy	04	03	1	-
2	Solar and Wind Energy	18	31	2	2 ½
3	Fuel Cells and MHD Generator	10	13	1	1
4	Bio and Tidal Energy	18	29	3	2
5	Steam and Nuclear Power Plants	25	34	3	2 ½
	<b>Total</b>	<b>75</b>	<b>110</b>	<b>10</b>	<b>08</b>

### OBJECTIVES

*On the completion of the course, the student should be able to*

#### 1.0 Introduction to Renewable Energy Sources

- 1.1 To appreciate the need of renewable energy sources
- 1.2 To state the different types of renewable energy sources
- 1.3 Understand the type of energy available - each type of energy sources

#### 2.0 Solar and Wind Energy

- 2.1 State the amount of solar radiation reaching the earth's surface
- 2.2 Determine the solar constant
- 2.3 State the principle of measuring solar radiation by pyranometer and pyrheliometer
- 2.4 State the principle of conversion of solar radiation into heat.
- 2.5 Explain the function of liquid flat collector
- 2.6 Explain the working principle of solar air heater with a sketch
- 2.7 State the application of solar air heater
- 2.8 Identify different types of concentrating collectors
- 2.9 Explain the working principle of concentrating collector (focusing type, parabolic trough collector and flat plate collectors with plain reflectors).
- 2.10 State the different methods of storing solar energy
- 2.11 Understand the methods of sensible heat, latent heat and thermo chemical storage.
- 2.12 Explain the working principle of solar pond with a sketch
- 2.13 State the applications of solar pond

- 2.14 Explain with the help of sketches the construction details and working principle of different types of solar water heater, solar space heater, absorption refrigerator type solar space cooler, solar still, cabinet and connective type of solar drier, box type solar cooker.
- 2.15 Understand the principle of photo –voltaic conversion.
- 2.16 State the working principle of solar cell
- 2.17 Explain the conversion energy and current voltage characteristics of solar cell.
- 2.18 State the use of photo voltaic cell for power generation
- 2.19 Understand the solar photovoltaic arrays.
- 2.20 Explain the solar water pumping system with a sketch
- 2.21 State the advantages and limitations of solar energy conversion.
- 2.22 Understand the power available in the wind and force caused by it on the blades.
- 2.23 State the collection of wind data and estimate the energy
- 2.24 State the different considerations for site selection for installing wind mill.
- 2.25 Identify the basic components of a wind mill
- 2.26 Explain the construction details on the working principle of the wind mill
- 2.27 State the differences between horizontal axis and vertical axis type wind mills
- 2.28 Explain the method of generation of electricity by wind mill

### **3.0 Fuel Cells and MHD Generator**

- 3.1 Understand the working principle of fuel cell
- 3.2 Explain the construction details and working principle of Bacon's High pressure fuel cell with a sketch
- 3.3 State the different types of fuels used in fuel cells
- 3.4 Explain the working principle of aluminium air fuel cell
- 3.5 Explain the working principle of MHD Generator

### **4.0 Bio and Tidal Energy**

- 4.1 Understand the meaning of bio-mass and bio-gas
- 4.2 State the principle of bio-gas generation
- 4.3 State the chemical composition and properties of bio-gas
- 4.4 State the applications of bio-gas
- 4.5 List out the different types of bio-gas plants
- 4.6 Explain the construction details and working principle of fixed dome type and floating dome type bio-gas plants with sketches
- 4.7 State the different materials used for bio-gas generation
- 4.8 Express bio-gas plant capacity  
State the method of starting of bio-gas plant.
- 4.9 State the methods of generator control and load control
- 4.10 Identify the energy available in tides and its usefulness in conversion
- 4.11 State the working principle of tidal power plant
- 4.12 State the different operation methods of utilisation of tidal energy
- 4.13 Understand single basin and double basin arrangements
- 4.14 State the site requirements for installation of tidal power plant
- 4.15 State the advantages and limitations of tidal power generation

### **5.0 Analyse the elements of Thermal and Nuclear Power Plants.**

- 5.1 Draw the layout of a thermal power plant.
- 5.2 Explain the layout.

- 5.3 Locate the Boiler, superheater, turbine , Electric Generator, Condenser and hot well pump in the layout.
- 5.4 Explain function of circulating water pump, Economiser , Air heater, Soot – Blower.
- 5.5 Explain the dust extraction , Electrostatic precipitator.
- 5.6 Explain about the ash removal , water cooling.
- 5.7 Explain about the feed water treatment.
- 5.8 Explain about the coal handling
- 5.9 Explain about the coal storage.
- 5.10 Identify the fuel handling equipment.
- 5.11 Trace the ash disposal system.
- 5.12 State the necessity of condensing the steam
- 5.13 State the principle of condensation in condenser
- 5.14 Explain the working of Jet condenser (high level and low level types).
- 5.15 Explain the surface condensers (shell and tube type only)
- 5.16 Compare the surface condensers with Jet condensers
- 5.17 Define condenser efficiency and vacuum efficiency
- 5.18 Simple problems on condensers
- 5.19 Understand the chain reaction
- 5.20 Understand the process of nuclear fission and nuclear fusion.
- 5.21 Know nuclear fuels
- 5.22 State the characteristics of atomic power plants
- 5.23 Explain the principle of working of a nuclear reactor
- 5.24 Classify the nuclear reactor
- 5.25 Explain the working principle of : (i) PWR (ii) BWR power plant.
- 5.26 Explain the working principle of : (i) GCR (ii) Liquid metal - C.R. Power plant.
- 5.27 Explain about the nuclear power in India.
- 5.28 Compare the nuclear and thermal plants.
- 5.29 Explain the natural Uranium, Uranium oxide, Uranium Carbide.
- 5.30 Explain the properties of a good cladding material.
- 5.31 State the cladding and structural materials
  - (i) Magnesium
  - (ii) Beryllium(iii) Stainless steel (iv) Zirconium.
- 5.32 Define the coolants i.e., low melting point, high boiling point.
- 5.33 Explain the properties of coolants
  - (i) Water (ii) Gases (iii) liquid metal coolants (iv) organic liquids
- 5.34 Explain the properties of materials used as good moderators.
- 5.35 Explain the moderating and reflecting materials
  - (i) water (ii) Heavy Water (D<sub>2</sub>O) (iii) Graphite (iv) Beryllium
- 5.36 List out the desirable properties of control rod materials.
- 5.37 List the control rod materials.
  - (i) Boron (ii) Cadmium
  - (iii) Hafnium (iv) Shielding materials
  - (v) concrete (vi) steel
- 5.38 Explain the effects of nuclear radiation
- 5.39 Explain the disposal of nuclear waste
  - (i) Ground (ii) Air (iii) Ocean

## COURSE CONTENTS

**1.0 Introduction:** Need for alternate sources of energy – types of non conventional energy sources – solar energy, wind energy, energy from bio- mass and bio-gas, tidal and wave energy, hydrogen energy, fuel cells

### 2.0 Solar and Wind Energy

2.1 Solar Radiation: Solar constant – solar radiation at earth's surface – instruments for measuring solar radiation – pyranometer, pyrheliometer.

2.2 **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) – parabolic collector –plate collectors with plane reflectors.

2.3 **Solar Energy Storage:** Methods of storing solar energy – sensible heat storage , latent heat storage and thermo chemical storage – solar pond – working principle and description of solar pond with a schematic diagram – applications of solar pond.

#### 2.4 Solar Energy Applications

i) Solar water heater – natural circulation type and forced circulation type.

ii) Solar space heater – passive type and active type

iii) Solar space cooling – absorptive refrigeration system

iv) Solar still

v) Solar drier – cabinet type and convective type

vi) Solar cooker and box type

2.5 **Photo voltaic conversion** – solar cell – working principle – conversion efficiency and current voltage characteristics of a solar cell – photo voltaic cell for power generation solar photo voltaic arrays – solar water pumping system – Advantages and disadvantages of solar energy.

2.6 **Wind Energy** : Introduction – power in the wind forces on the blades – wind data – energy estimation – 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 — electric generation by wind mill – generator control – load control.

**3.0 Fuel Cells and MHD Generator:** working principle – Bacon'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

4.1 **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 drome 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.

4.2 **Tidal Energy** : Introduction to tidal power – components of tidal power plants – operation methods of utilisation of tidal energy – single basin and double basin arrangements- site requirements – advantages and limitations of tidal power generation.



## **5.0 Steam and Nuclear Power Plant**

### **5.1 Steam Power Plant**

Layout of a Thermal Power Plant, Choice of sight, explanation of important elements in layouts:- Such as Boiler, Condenser , Feed water system, Circulating water pumps ,Economiser, Air heater, Soot-Blower , Forced draught Fan, Dust collectors, Electro static precipitator

Supporting activities:- Such as Water cooling, Feed water treatment, Coal handling, Coal storage , Chimney.

Description of fuel handling equipment, unloading equipment, preparing equipment, modern ash handling equipment, dust collection and disposal , roots blower, condensers, principles classification – comparison – condensers and vacuum efficiencies and simple problems.

### **5.2 Nuclear – Power Plants**

Nuclear energy chain reaction , reactor, nuclear fission , nuclear fusion, characteristics of automatic power plants, nuclear fuels , working principle of nuclear reactor, classification of reactors, working principle of PWR and BWR , Gas – Cooled reactor, liquid metal – cooled reactor, nuclear power in India , Comparison between nuclear and thermal plants.

### **5.3 Nuclear Materials and Waste Disposal**

Natural Uranium, Uranium Oxide, Uranium Carbide, Cladding and structural materials, Coolants ,moderating and reflecting materials , control rod materials, Shielding materials , effects of nuclear radiation, disposal of nuclear waste.

## **REFERENCE BOOKS**

1. Non conventional Energy source by G.D Rai.
2. Energy Technology by S. Rao & Dr. D.B. Palekr (Non conventional , Renewable and conventional)
3. Solar energy utilisation by G.D.Rai
4. Introduction to alternate sources of energy by TTTI, Madras
5. Solar energy by S.P. Sukhatme
6. Advances in bio-gas technology by O.P.Chawla.

## CAD LAB-II

**Subject Title** : **CAD LAB-II**  
**Subject Code** : **M-607**  
**Periods/ week** : **03**  
**Periods per Semester** : **45**

### **OBJECTIVES**

1. Appreciate the importance of Solid Modeling software like PRO-E / UNIGRAPHICS / CATIA
2. Use any of the solid modeling packages stated above and generate a solid model of a machine component

### **COURSE CONTENTS**

1. Study of Solid modeling software ( PRO-E / UNIGRAPHICS / CATIA)
2. Generate a solid model of the given Machine component for analysis purpose.

## **CAM-LAB**

<b>Subject Title</b>	<b>:</b>	<b>CAM-LAB</b>
<b>Subject Code</b>	<b>:</b>	<b>M-608</b>
<b>Periods/ week</b>	<b>:</b>	<b>03</b>
<b>Periods per Semester</b>	<b>:</b>	<b>45</b>

### **OBJECTIVES**

1. Use incremental system and absolute system on dimensioning.
2. Identify the parts and functions of CNC lathe.
3. Write simple part program, edit and execute using CNC lathe machine simulation package.
4. Prepare part program and produce part using CNC lathe machine.

### **COURSE CONTENTS**

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 canned cycle.
7. Turing exercise – circuits interpolation CW, CCW.
8. Turning Exercise - Taper turning and Peck drilling.
9. Turning exercise – Thread cutting and grooving.

## THERMAL ENGINEERING LAB

Subject Title : THERMAL ENGINEERING LAB  
Subject Code : M – 609  
Periods Per Week : 03  
Periods Per Semester : 24

### TIME SCHEDULE

S. No.	Name of Experiment	periods
1	Valve Timing Diagram	3
2	Load Test	3
3	Heat balance Sheet	3
4	Economic Speed Test	3
5	Morse Test	3
6	Air compressor	3
7	Marcet Boiler	3
8	Study of wind mills and solar appliances	3
	TOTAL	<b>24</b>

### OBJECTIVES

1. To Know the importance of valve timing and port timing diagrams
2. Know the importance of economic speed, heat balance and performance characteristics of IC engines.
3. To know the importance of economic speed of engines.
4. Identify the application of Morse test.
5. Know the importance of Marcet Boiler.
6. To know the importance of volumetric efficiency of reciprocating Air compressor
7. Identify the types of wind mills.
8. Appreciate the importance of wind mills in non conventional energy sources.
9. Identify different types of solar appliances.
10. Appreciate the importance of solar energy in non conventional energy sources.

### COURSE CONTENTS

1. Valve timing diagrams
2. Economic speed Test..
3. Morse test.
4. Performance curves .
5. Heat Balance Sheet.
6. Investigation of Pressure Vs Temperature relationship of saturated steam.
7. Volumetric efficiency of Reciprocating Air compressor by Orifice method and tank capacity method.
8. Study of different types of windmills.
9. Study of wind speed measuring instruments.
10. Study of solar radiation instruments.  
Study of performance testing on Solar appliances such as collectors, Heaters, Stills, Coolers, Driers, Photovoltaic cell.

## R & A/C LABORATORY

<b>Subject Title</b>	:	R & A/C Laboratory
<b>Subject Code</b>	:	<b>M – 610</b>
<b>Periods Per Week</b>	:	<b>03 per two weeks</b>
<b>Periods Per Semester</b>	:	<b>21</b>

### TIME SCHEDULE

<b>S.No</b>	<b>Exercise</b>	<b>Number of Periods</b>
1	Familiarisation with R&AC Tools , Basic operations on copper tube	03
2	C O P of Vapour Compression System	03
3	Study of Domestic Refrigerator	03
4	Study of Electrolux Refrigerator	
5	Study of Water Cooler	03
6	Study of Ice Plant and Cold Storage	03
7	Study and Performance of A.C. System	06
8	Servicing & Maintenance of R & AC Equipment	
	<b>Total</b>	<b>21`</b>

### OBJECTIVES

1. Identify various tools used in R&AC
2. To identify the various components of a VC system and to draw the refrigerant circuit and the electrical circuit
3. To evaluate the C O P of a given Vapour Compression system
4. To study Domestic Refrigerator , Electrolux Refrigerator , Water Cooler, Ice Plant or Cold Storage.
5. To identify the various components of an AC system
6. To evaluate the performance of an AC system
7. Servicing and Maintenance of R& AC Equipment –Trouble shooting

## **COURSE CONTENTS**

1. Study of basic tools used in R&AC equipment
2. Study of vapour compression refrigeration system.
3. Study and use of equipment used in vapour compression system.
4. Determination of COP of Vapour Compression system.
5. Study of domestic refrigerator.
6. Study of Electrolux refrigerator.
7. Study of Water Cooler.
8. Study of Ice plant.
9. Study of Cold Storage.
10. Study of air conditioning system (window type Air conditioner and split type unit)
11. Performance testing of air conditioning system.
12. Servicing and maintenance of R&AC equipment and trouble shooting

## WORK SHOP PRACTICE-IV

<b>Subject Title</b>	<b>:</b>	<b>Work shop practice-IV</b>
<b>Subject Code</b>	<b>:</b>	<b>M-611</b>
<b>Periods/Week</b>	<b>:</b>	<b>3</b>
<b>Periods per Semester</b>	<b>:</b>	<b>22 ½</b>

### **OBJECTIVES**

*On the completion of the course the student should be able to*

#### **1.0 Milling machine , slotting machine , Planning machine and grinding machines**

- 1.1 To Know the operation of milling machine and slotting machine.
- 1.2 Perform various operations on milling machine and slotting machine
- 1.3 To know the operation of planning machine.
- 1.4 Perform various operations on planning machine
- 1.5 To know the operation of surface grinding machine and tool and cutter grinding machine
- 1.6 perform various operations on surface grinding and tool and cutter grinder machine

### **COURSE CONTENTS**

#### **I. Machine Shop.**

1. Key way cutting by slotting machine.
2. Indexing method in slotting machine
3. T-slot cutting on milling machine.
4. Bevel gear / Helical gear cutting on milling machine
5. Planning operations
6. preparation of plain surface with planning machine
7. preparation of rectangular block of precise dimensions by using surface grinding machine.
8. Sharpening of lathe tools, milling cutter and drill bit by using tool and cutter grinder.

## SERVICING AND MAINTENANCE LAB

<b>Subject Title</b>	<b>:</b>	<b>Servicing and Maintenance Lab</b>
<b>Subject Code</b>	<b>:</b>	<b>M-612</b>
<b>Periods/Week</b>	<b>:</b>	<b>03 per week</b>
<b>Periods per Semester</b>	<b>:</b>	<b>22 ½</b>

### **OBJECTIVES**

*On completion of the course the student should be able to*

#### **1.0 Servicing and maintenance.**

- 1.1 Handle the hand tools used on shop floor
- 1.2 understand the importance of servicing and maintenance and know some Servicing methods of machine tools, sewing machine, pumps etc.
- 1.3 Know the testing and inspection methods of machine tools.
- 1.4 Dismantle and assemble machine tools.
- 1.5 Recondition the parts.
- 1.6 Service and overhaul machines of general nature.
- 1.7 Locate the faults and rectify the same.
- 1.8 Prepare maintenance schedules and estimates.
- 1.9 Know the servicing methods of IC-Engine parts.
- 1.10 Overhauling of petrol and diesel Engines.
- 1.11 Locate fault finding and rectify the same.
- 1.12 Prepare maintenance Schedules and estimations.
- 1.13 Selection of Appropriate recovery methods for a given machine elements And performing recovery processes by using appropriate methods such as arc/gas welding, metal spraying, applying adhesives etc.,

### **COURSE CONTENTS**

#### **Servicing & Maintenance Laboratory**

- 1. Effective handling / use of different hand tools used by a service engineer.
- 2. Sub – assembly of small components such as, Tail stock, checks of lathes( 3-jaw chuck,4-jaw chuck.)
- 3. Measurement of wear on M/c elements such as, lathe beds, guide ways & shapers.
- 4. Selection of appropriate recovery methods for a given M/c element and performing recovery processes by using appropriate methods such as:  
Arc/Gas Welding, Metal spraying, Applying adhesives etc.



5. Fault finding and repairs of equipment such as machine tools, washing machines, sewing machine, water pumps (centrifugal ,reciprocating and jet pumps),gas stove, Kerosene pump stove etc
6. Maintenance of various machine tools & engines including preparation of preventive maintenance schedule of a typical workshops .
6. Maintenance of Carburettor, Injectors , fuel pump, Piston Assembly , Gear Box, Clutch , Valve Assembly, Propeller Shaft and Universal Joint, Differential , Axles etc.,

NOTE: The students of the class will be divided in to two batches. One batch will attend the “ machine shop “and the other batch will attend Servicing and maintenance laboratory.

**PROJECT WORK**

**Subject Title** : **Project Work**  
**Subject Code** : **M-613**  
**Periods/Week** : **03 per week**  
**Periods per Semester** : **45**