GOVERNMENT OF ANDHRA PRADESH

STATE BOARD OF TECHNICAL EDUCATION AND TRAINING
Andhra Pradesh :: Amaravathi

Globally Competetive
CURRICULUM (C-16)
For Polytechnic Diploma Courses In Andhra Pradesh

INTERNET of THINGS

DIPLOMA IN MECHANICAL ENGINEERING

Front Cover Page

Objective of the New Curriculum (C-16)

To make the students 'Globally Competetive & Employable' by learning industry relevant subjects & undergoing Industrial training

Suggestions from Industrialists have been incorporated in the Curriculum by organising **Industry Institute Interaction Meet.**

Highlights of the Curriculum (C-16)

❖ 6 months /1 year industrial training in all the Diploma Courses.

❖ 1 year industrial training in collaboration with BOAT (Board of Apprenticeship & Training (SR), Chennai).

❖ Virtual labs for ECE & Computer Branches & Strengthening of Skill Development Centers to provide industrial training to students.

Fundamentals of 'Internet of Things' (IoT) is included for all the Branches in the Subject "Industrial Management & Smart Technologies".

"Communication Skills" and "Life Skills" have been introduced as practical subjects for all the Branches.

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"Computer Fundamentals Laboratory" is introduced for all the Branches in First year. AutoCAD specific to the Branch has been given emphasis in the Curriculum.

C Language, Programmable Logic Controllers (PLC), Microcontrollers, Solar Energy are introduced in Electrical Engineering Branch.
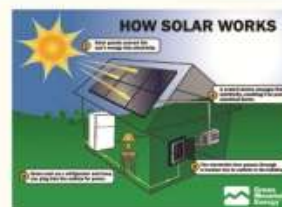
Mobile Communications, Consumer Electronics are introduced in Electronics and Communication Branch

CAD/ CAM, CNC Machines, Power Plant Engineering are introduced in Mechanical Engineering Branch.

OOPS through JAVA, Web Designing, Computer Hardware & Networking are introduced in Computer Engineering Branch.

Automobile Chassis and Body Engineering, Recent Trends In Automobile Engineering, Motor Transport Organization etc are introduced in Automobile Engineering Branch.

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Journal (JPAP)

The Department of Technical Education, A.P. has a bi- annual 'Journal of Polytechnics of Andhra Pradesh' JPAP

CISCO

CISCO ACADEMIES IN POLYTECHNICS

◆ 70 Government Polytechnics chosen to have Cisco Academies
◆ Course Content of CISCO has been incorporated into the ECE and Computer Diploma Courses
◆ CISCO to train Staff of Polytechnics in two phases to enable them to run the courses effectively
◆ Students to get 'Certificate from CISCO' along with Diploma Certificate.

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CURRICULUM-2016
(C-16)

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 needs of the industries and enhancing the employability skills of Polytechnic students, the Government of Andhra Pradesh constituted a committee vide G.O.Rt.No:95 of Higher Education (TE) Dept dated: 29-4-2016 and G.O.Rt.No:98 of Higher Education (TE) Dept dated: 4-5-2016 for updation of polytechnic curriculum under the chairmanship of Sri. S. Balasubrahmanyam, IAS (Retd.,). The committee submitted a report on 31-5-2016 making certain recommendations and suggesting new initiatives to be incorporated in the curriculum. An Industry Institute Interaction Meet was organized with Industry experts and subject experts on 26-12-2016 and the suggestions from Industrialists have also been incorporated in the curriculum. 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, besides reviewed by Expert Committee constituted with eminent academicians.

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.

The revised New Curriculum i.e., Curriculum–2016 (C-16) is approved by BoG of SBTET for its implementation with effect from 2016-17.

Salient Features:
1. Duration of course is either 3 years / 3½ years duration of Regular Academic Instruction.
2. The Curriculum is prepared in Semester Pattern. However, First Year is maintained as Year-wise pattern.
3. 6 Months/ 1 year Industrial Training is introduced for all the Diploma courses.
4. Fundamentals of Internet of Things (IOT) is introduced for all the Diploma courses in the subject.

5. Modern subjects relevant to the industry are introduced in all the Diploma courses.

6. CISCO course content has been incorporated into the ECE and CME courses to get certification from CISCO along with Diploma.

7. The policy decisions taken at the State and Central level with regard to environmental science are implemented by including relevant topics in Chemistry. This is also in accordance with the Supreme Court guidelines issued in Sri Mehta's case.

8. Keeping in view the increased need of communication skills which is playing a major role in the success of Diploma Level students in the Industries, emphasis is given for learning and acquiring listening, speaking, reading and writing skills in English. Further as emphasized in the meetings, Communication Skills lab and Life Skills lab are introduced for all the branches.

9. Modern topics relevant to the needs of the industry and global scenario suitable to be taught at Diploma level are also incorporated in the curriculum.

10. AutoCAD specific to the branch has been given more emphasis in the curriculum. Preparing drawings using CAD software has been given more importance.

11. Every student is exposed to the computer lab at the 1st year itself in order to familiarize himself with skills required for keyboard/mouse operation, internet usage and e-mailing.

12. Upon reviewing the existing C-14 curriculum, it is found that the theory content is found to have more weightage than the Practical content. In the revised C-16 curriculum, more emphasis is given to the practical content of Laboratories and Workshops, thus strengthening the practical skills.

13. With increased emphasis for the student to acquire Practical skills, the course content in all the subjects is thoroughly reviewed and structured as outcome based than the conventional procedure based.

14. Curricula of Laboratory and Workshops have been thoroughly revised based on the suggestions received from the industry and faculty, for better utilization of the equipment available at the Polytechnics. The experiments /exercises that are chosen for the practical sessions are identified to conform to the field requirements of industry.

15. The Members of the working group are grateful to Sri G.S. Panda Das, I.A.S., Special Commissioner of Technical Education & Chairman of SBTET, AP. and Sri. Adityanath Das, I.A.S., Principal Secretary of Higher Education for their guidance and valuable inputs in revising, modifying and updating the curriculum.

16. The Members acknowledge with thanks the cooperation and guidance provided by Sri. A.Nirmal Kumar Priya, Secretary, SBTET, Andhra Pradesh and other officials of Directorate of Technical Education and the State Board of Technical Education, Andhra Pradesh, experts from industry, academia from the universities and higher learning institutions and all teaching fraternity from the Polytechnics who are directly or indirectly involved in preparation of the curricula.

RULES AND REGULATIONS

1 DURATION AND PATTERN OF THE COURSES

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

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

2 PROCEDURE FOR ADMISSION INTO THE DIPLOMA COURSES:

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

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

Only the candidates satisfying the following requirements will be eligible to appear for

the Common Entrance Test for admissions into Polytechnics (POLYCET).

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

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

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

3 MEDIUM OF INSTRUCTION

The medium of instruction and examination shall be English.

4 PERMANENT IDENTIFICATION NUMBER (PIN)

A cumulative / academic record is to be maintained of the Marks secured in sessional work and end examination of each year for determining the eligibility for

promotion etc., A Permanent Identification Number (PIN) will be allotted to each admitted candidate to maintain academic records.

5   NUMBER OF WORKING DAYS PER SEMESTER / YEAR:

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

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

c). There shall be 7 periods of 50 minutes duration 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 the syllabus.

6   ELIGIBILITY OF ATTENDANCE TO APPEAR FOR THE END EXAMINATION

a). A candidate shall be permitted to appear for the end examination in all subjects, if he or she has attended a minimum of 75% of working days during the year/Semester.

b). Condonation of shortage of attendance in aggregate upto 10% (65% and above and below 75%) in each semester or 1st year may be granted on medical grounds.

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

d). Candidates having less than 65% attendance shall be detained.

e). Students whose shortage of attendance is not condoned in any semester / 1st year and not paid the condonation fee in time are not eligible to take their end examination of that class and their admissions shall stand cancelled. They may seek re-admission for that semester / 1st year when offered next.

7   READMISSION

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

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

   b) For Industrial Training: before commencement of the Industrial training.

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

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

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

8   SCHEME OF EXAMINATION

a) First Year

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.

b) III, IV, V, VI and VII Semesters:

THEORY EXAMINATION: Each subject carries usually 80 marks and 30 marks in respect of specified subjects of 3hours duration, along with 20 marks for internal evaluation (sessional marks) respectively.

PRACTICAL EXAMINATION: Each subject carry 60/30 marks of 3hours duration 40/20 sessional marks.

9   INTERNAL ASSESSMENT SCHEME

a)   Theory Subjects: Theory Subjects carry 20% sessional marks, Internal examinations will be conducted for awarding sessional marks on the dates specified. **Three unit tests will be conducted for I year students and two Unit Tests for semesters.** Average of marks obtained in all the prescribed tests will be considered for awarding the sessional marks.

b)   Practical Subjects: Student's performance in Laboratories / Workshop shall be assessed during the year/ semester of study for 40% marks in each practical subject. Allotment of marks should be discrete taking into consideration of 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.

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

d) For practical examinations, except in drawing, there shall be two examiners. External examiner shall be appointed by the Principal in consultation with respective Head of Section preferably choosing a qualified person from any local Industry/ nearby Government Polytechnic/ Local Government Organization. Internal examiner shall be the person concerned with internal assessment as in (c) above. The end examination shall be held along with all theory papers in respect of drawing.

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

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

g) **In case of Diploma courses *having* Industrial Training**, the training assessment shall be done and the marks are to be awarded in the following manner.

Industrial assessment	:	200 marks (in two spells of 100 marks each)
Maintenance of log book	:	30 marks
Record Work	:	30 marks
Seminar / viva-voce	:	40 marks

TOTAL	:	300 marks

The assessment at the institution level (Seminar/Viva-voce)shall be done by three members, viz., Internal Faculty member, External Examiner and Head of Section and be averaged.

10   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 end

examination marks put together. In case of D.C.C.P., the pass mark for typewriting and short hand is 45% in the end examination. There are no sessional marks for typewriting and Shorthand subjects of D.C.C.P course.

11.   PROVISION FOR IMPROVEMENT

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

2.   Improvement is allowed in any 4 (Four) subjects of the Diploma.

3.   The student can avail of this improvement chance **ONLY ONCE**, that too within the succeeding two examinations after the completion of Diploma. However, the duration including Improvement examination shall not exceed <u>FIVE</u> years from the year of first admission.

4.   No improvement is allowed in Practical / Lab subjects or Project work or Industrial Training assessment. However, improvement in drawing subject(s) is allowed.

5.   If improvement is not achieved, the marks obtained in previous Examinations hold good.

6.   Improvement is not allowed in respect of the candidates who are punished under Mal-practice in any Examination.

7.   Examination fee for improvement shall be paid as per the notification issued by State Board of Technical Education and Training from time to time.

8.   All the candidates who wish to appear for improvement of performance   shall deposit the original Marks Memos of all the years / Semesters and also original Diploma Certificate to the Board.   If there is improvement in performance of the current examination, the revised Memorandum of marks and Original Diploma Certificate will be issued, else the submitted originals will be returned.

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

a) For Diploma Courses of 3 Years duration

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

ii.   A candidate shall be promoted to 3rd 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 3rd semester.

iii. A candidate shall be promoted to 4th semester provided he/she puts the required percentage of attendance in the 3rd semester and pay the examination fee. A candidate who could not pay the 3rd 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 4th semester.

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

i) Puts the required percentage of attendance in the 4th semester

ii) Should not have failed in more than Four backlog subjects of 1st year

For IVC & ITI Lateral Entry Students:

A candidate is eligible to appear for the 4th semester examination if he/she puts the required percentage of attendance in the 4th semester

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

A candidate is eligible to appear for the 5th semester examination if he/she

i) Puts the required percentage of attendance in the 5th semester

ii) Should get eligibility to appear for 4th Semester examination.

For IVC& ITI Lateral Entry students:

i) Puts the required percentage of attendance in the 5th semester
ii) Should not have failed in more than Four backlog subjects of 3rd Semester

v) A candidate shall be promoted to 6th semester provided he/she puts in the required percentage of attendance in the 5th semester and pay the examination fee. A candidate who could not pay the 5th 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 6th semester.

A candidate is eligible to appear for 6th semester Industrial Training assessment (Seminar/Viva-voce)

i) Puts the required percentage of attendance, ie., 90% in 6th semester Industrial

Training

ii) Should get eligibility to appear for 4th Semester Examination.

For IVC & ITI Lateral Entry students:

i) Puts the required percentage of attendance, ie., 90% in 6th semester Industrial Training.
ii) should get eligibility to appear for 5th Semester Examination.

Important Note:

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

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

1. A candidate shall be permitted to appear for 1st 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 3rd semester if he/she puts the required percentage of attendance in the 1st year and pays the examination fee. A candidate who could not pay the 1st 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 3rd semester.
3. A candidate shall be promoted to 4th semester provided he/she puts the required percentage of attendance in the 3rd semester and pay the examination fee. A candidate, who could not pay the 3rd 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 4th semester.
    A candidate is eligible to appear for the 4th semester exam if he/she

    i) Puts the required percentage of attendance in the 4th semester
    ii) Should not have failed in more than Four backlog subjects of 1st year.

For IVC & ITI Lateral Entry students:

(i) Puts the required percentage of attendance in the 4th semester

4. A candidate shall be promoted to 5th semester industrial training provided he / she puts the required percentage of attendance in the 4th semester and pays the examination fee. A candidate, who could not pay the 4th semester examination fee, has to pay the

promotion fee as prescribed by State Board of Technical Education and Training from time to time before commencement of 5th semester.

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

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

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

A candidate is eligible to appear for 7th semester examination if he/she

   i) Puts the required percentage of attendance in the 7th semester
   ii) Should get eligibility to appear for 4th semester Examination.

For IVC & ITI Lateral Entry students:

   i) Puts the required percentage of attendance in the 7th semester
   ii) Should not have failed more than four backlog subjects of 3rd Semester

OTHER DETAILS

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

   b) The I spell of Industrial training shall commence 10 days after the completion of the last theory examination of 4th Semester.

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

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

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

   1. 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.

2. A candidate shall be promoted to 3rd 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 3rd semester.

3. A candidate shall be promoted to 4th semester provided he/she puts the required percentage of attendance in the 3rd semester and pay the examination fee. A candidate who could not pay the 3rd 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 4th semester.

> A candidate is eligible to appear for the 4th semester examination if he/she
>
> i) Puts the required percentage of attendance in the 4th semester
>
> ii) Should not have failed in more than Four backlog subjects of 1st year

For IVC & ITI Lateral Entry Students:

> A candidate is eligible to appear for the 4th semester examination if he/she puts the required percentage of attendance in the 4th semester

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

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

i) Puts the required percentage of attendance in the 5th semester

ii) Should get eligibility to appear for 4th Semester examination.

For IVC & ITI Lateral Entry students:

> iii) Puts the required percentage of attendance in the5th semester
> iv) Should not have failed in more than Four backlog subjects of 3rd Semester

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

A candidate who could not pay the 5th 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 6th semester.

A candidate is eligible to appear for 6th semester examination

 i) Puts the required percentage of attendance in 6th semester and

ii)   should get eligibility to appear for 4th Semester Examination.

For IVC & ITI Lateral Entry students:

  i)   Puts the required percentage of attendance in 6th semester.
  ii)   should get eligibility to appear for 5th Semester Examination.

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

A candidate is eligible to appear for 7th semester Industrial Training assessment

(Seminar/Viva-voce) if he/she

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

For IVC & ITI Lateral Entry students:

  i)   Puts the required percentage of attendance, ie., 90% in 7th semester Industrial
       Training.
  ii)   Should get eligibility to appear for 5th Semester Examination.

Important Note:

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

OTHER DETAILS

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

b) The Industrial training shall commence 10 days after the completion of the last

theory examination of 6th Semester

13. 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%.

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

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

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

14. EXAMINATION FEE SCHEDULE:

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

15. STRUCTURE OF END EXAMINATION QUESTION PAPER:

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 hours duration.

a) 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.

b) 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.

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

Max. Marks for an experiment / exercise   : 50%

Max. Marks for VIVA-VOCE   : 10%

Total   : 60% (of total marks for the subject)

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.

16.   ISSUE OF MEMORONDUM OF MARKS

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

17.   MAXIMUM PERIOD FOR COMPLETION OF DIPLOMA COURSES:

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

18.   ELIGIBILITY FOR AWARD OF DIPLOMA

A candidate is eligible for award of Diploma Certificate if he / she 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.

For IVC & ITI Lateral Entry students:

i.   He / She pursued a course of study for not less than 2 / 2 ½ academic years & not more than 4 / 5 academic years.

ii.   He / she has completed all the subjects.

Students who fail to fulfill all the academic requirements for the award of the Diploma within 4 / 5 academic years from the year of admission shall forfeit their seat in the course & their seat shall stand cancelled.

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

A) FOR ISSUE OF PHOTO COPIES OF VALUED ANSWER SCRIPTS

1.   A candidate desirous of applying for Photo copy of valued answer script/ scripts should apply within prescribed date from the date of the declaration of the result.

2.   Photo copies of valued answer scripts will be issued to all theory subjects and Drawing subject(s).

3.   The Photo copy of valued answer script will be dispatched to the concerned candidate's address as mentioned in the application form by post.

4.   No application can be entertained from third parties.

B) FOR RE-COUNTING(RC) and RE-VERIFICATION(RV) OF THE VALUED ANSWER SCRIPT

1.   A candidate desirous of applying for Re-verification of valued answer script should apply within prescribed date from the date of the declaration of the result.

2.   Re-verification of valued answer script shall be done for all theory subjects and Drawing subject(s).

3.   The Re-verification committee constituted by the Secretary, SBTETAP with subject experts shall re-verify the answer scripts.

I) RE-COUNTING

The Officer of SBTET will verify the marks posted and recount them in the already valued answer script. The variations if any will be recorded separately, without making any changes on the already valued answer script. The marks awarded in the original answer script are maintained (hidden).

2) RE-VERIFICATION

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

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

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

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

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

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

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

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

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

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

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

20.   MAL PRACTICE CASES:

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

21.   DISCREPANCIES/ PLEAS:

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

22.   ISSUE OF DUPLICATE DIPLOMA

If a candidate loses his/her original Diploma Certificate and desires a duplicate to be issued he/she should produce written evidence to this effect. He / she may obtain a duplicate from the Secretary, State Board of Technical Education and Training, A.P., on payment of prescribed fee and on production of an affidavit signed   before a First Class Magistrate (Judicial) and *non-traceable certificate* from the Department of Police. In case of damage of original Diploma Certificate, he / she may obtain a duplicate certificate by surrendering the original damaged certificate on payment of prescribed fee to the State Board of Technical Education and Training, A.P.

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

23.   ISSUE OF MIGRATION CERTIFICATE AND TRANSCRIPTS:

The Board on payment of prescribed fee will issue these certificates for the candidates who intend to prosecute Higher Studies in India or Abroad.

24.   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 Vijayawada.

iii.   In case of any ambiguity in the interpretation of the above rules, the decision of the Secretary, SBTET, A.P is final.

DIPLOMA IN MECHANICAL ENGINEERING
SCHEME OF INSTRUCTION AND EXAMINATION
CURRICULUM-16

First Year

Sub code	C16-Subjects	No of Periods per week		Total periods per year	Scheme of Examination			
		Theory	Practical		Duration (Hrs)	Sessional Marks	End Exam Marks	Total Marks
THEORY								
M-101	English	3		90	3	20	80	100
M-102	Engineering Mathematics-I	5		150	3	20	80	100
M-103	Engineering Physics	4		120	3	20	80	100
M-104	Engineering Chemistry & Environmental Studies	4		120	3	20	80	100
M-105	Engineering Mechanics	4		120	3	20	80	100
M-106	Workshop Technology	4		120	3	20	80	100
PRACTICAL								
M-107	Engineering Drawing		6	180	3	40	60	100
M-108	Basic Workshop Practice		6	180	3	40	60	100
M-109	Physics laboratory		1½	45	1½	20	30	50
M-110	Chemistry Laboratory		1½	45	1½	20	30	50
M-111	Computer Fundamentals Laboratory		3	90	3	40	60	100
	T O T A L	**24**	**18**	**1260**		**280**	**720**	**1000**

DIPLOMA IN MECHANICAL ENGINEERING
SCHEME OF INSTRUCTION AND EXAMINATION
CURRICULUM-16

III Semester

Sub code	C16-Subjects	No of Periods per week		Total periods per semester	Scheme of Examination			
		Theory	Practice		Duration (Hrs)	Sessional Marks	End Exam Marks	Total Marks
THEORY								
M-301	Engineering Mathematics-II	5		75	3	20	80	100
M-302	Strength of Materials	6		90	3	20	80	100
M-303	Thermal Engineering-I	6		90	3	20	80	100
M-304	Production Technology-I	5		75	3	20	80	100
M-305	Basic Electrical Engineering & Electronics	5		75	3	20	80	100
PRACTICAL								
M-306	Machine Drawing		6	90	3	40	60	100
M-307	Fuels lab and Electrical Engineering Lab		3	45	3	20+20	30+30	100
M-308	Materials testing lab		3	45	3	40	60	100
M-309	Workshop Practice-II		3	45	3	40	60	100
	T O T A L	**27**	**15**	**630**		**260**	**640**	**900**

DIPLOMA IN MECHANICAL ENGINEERING
SCHEME OF INSTRUCTION AND EXAMINATION
CURRICULUM-16

IV Semester

Sub code	C16-Subjects	No of Periods per week		Total periods per semester	Scheme of Examination			
		Theory	Practice		Duration (Hrs)	Sessional Marks	End Exam Marks	Total Marks
THEORY								
M-401	Engineering Materials	6		90	3	20	80	100
M-402	Hydraulics and Fluid Power Control Systems	6		90	3	20	80	100
M-403	Thermal Engineering II	6		90	3	20	80	100
M-404	Production technology-II	6		90	3	20	80	100
M-405	Design of Machine Elements	6		90	3	20	80	100
PRACTICAL								
M-406	Production Drawing		3	45	3	40	60	100
M-407	Hydraulics & Fluid Power Control Systems Lab		3	45	3	40	60	100
M-408	Communication Skills		3	45	3	40	60	100
M-409	Thermal Engineering Lab		3	45	3	40	60	100
	T O T A L	**30**	**12**	**630**		**240**	**560**	**800**

DIPLOMA IN MECHANICAL ENGINEERING
SCHEME OF INSTRUCTION AND EXAMINATION
CURRICULUM-16

V Semester

Sub code	C16-Subjects	No of Periods per week		Total periods per semester	Scheme of Examination			
		Theory	Practice		Duration (Hrs)	Sessional Marks	End Exam Marks	Total Marks
THEORY								
M-501	Industrial Management & Smart Technologies	5		75	3	20	80	100
M-502	Industrial Engineering - Estimating and Costing	6		90	3	20	80	100
M-503	Refrigeration & Air-conditioning	5		75	3	20	80	100
M-504	Energy sources & Power Plant Engineering	5		75	3	20	80	100
M-505	Computer Aided Manufacturing systems	5		75	3	20	80	100
PRACTICAL								
M-506	Computer Aided Drafting & CNC lab		6	90	3	40	60	100
M-507	Non-Conventional Energy sources and R&AC lab		3	45	3	40	60	100
M-508	Life Skills		3	45	3	40	60	100
M-509	Workshop Practice - III		4	60	3	40	60	100
	T O T A L	**26**	**16**	**630**		**260**	**640**	**900**

M-601 INDUSTRIAL TRAINING
(Practical Training)

<u>VI SEMESTER</u>

<u>Scheme of evaluation:</u>

S.No	Subject	Duration	Items	Max Marks	Remarks
1	M-601 Practical Training in the Industry	6 Months	1.First Assessment (at the end of 3rd month)	100	
			2. Second Assessment (at the end of 6th month)	100	
			3.Training report		
			i) Log Book	30	
			ii) Report	30	
			4. Seminar	40	
		Total :		300	

The industrial training shall carry 300 marks and pass marks are 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% attendence.

DIPLOMA IN MECHANICAL ENGINEERING
SCHEME OF INSTRUCTION AND EXAMINATION
CURRICULUM-16

First Year

Sub code	C16-Subjects	No of Periods per week		Total periods per year	Scheme of Examination			
		Theory	Practical		Duration (Hrs)	Sessional Marks	End Exam Marks	Total Marks
THEORY								
M-101	English	3		90	3	20	80	100
M-102	Engineering Mathematics-I	5		150	3	20	80	100
M-103	Engineering Physics	4		120	3	20	80	100
M-104	Engineering Chemistry & Environmental Studies	4		120	3	20	80	100
M-105	Engineering Mechanics	4		120	3	20	80	100
M-106	Workshop Technology	4		120	3	20	80	100
PRACTICAL								
M-107	Engineering Drawing		6	180	3	40	60	100
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M-109	Physics lab		1½	45	1½	20	30	50
M-110	Chemistry Lab		1½	45	1½	20	30	50
M-111	Computer Fundamentals Lab		3	90	3	40	60	100
	T O T A L	**24**	**18**	**1260**		**280**	**720**	**1000**

C-16-COMMON-101- ENGLISH
(Common to all Branches)

Subject Title	:	**ENGLISH**	
Subject Code	:	**Common - 101**	
Periods per Week	:	**3**	
Periods per Year	:	**90**	

Time Schedule

SI No	Major Topics	Titles of the Lessons	No. of Periods	Weightage of Marks	No of Short Answers	No of Long Answers
1	Vocabulary& Need for English	Lessons 1,2& Regular and essential vocabulary	5	13	1	1
2	Grammar	Lessons 11,12 & 19 to 26	30	31	7	1
3	Reading	Lessons 13 To 18	10	10	-	1
4	Writing	Lessons 27 To 40	30	40	-	4
5	English in Action	Lessons 3 To 10	15	16	2	1
		Total	**90**	**110**	**10**	**08**

Rationale and Scope

Globalization has ushered in an era of opportunities for those who have the necessary competencies. Effective communication is one among them. This shift demands strengthening of English in polytechnics. In C-16 Curriculum the focus is on the special needs of English for technicians.

This course aims at integration of the four fold language abilities viz., listening, speaking, reading and writing. The use of English for learning technical subjects and for performing technical functions like, writing reports, giving instructions and interpreting graphics/data is of great importance. Therefore the curriculum C-16 focuses on improving communicative abilities equipping the students to become industry-ready and employable.

On completion of this course the student will be able to:

1.0 Build vocabulary in the direction of future needs
2.0 Learn various grammatical structures
3.0 Read and comprehend English and understand the details and draw inferences
4.0 Learn to be competent in various forms of written communication (writing composition and data interpretation)
5.0 Practice spoken communication suited to various situations.

1.0 Extend their vocabulary in the direction of their future needs
1.1 Locate words, learn spellings, understand meanings
1.2 Pronounce words intelligibly
1.3 Find synonyms and antonyms
1.4 Use affixation
1.5 Comprehend meanings of words by understanding meanings of roots

2.0   Learn various grammatical structures
2.1   Identify and use nouns
2.2   Identify and use pronouns
2.3   Use the present tense
2.4   Use the past tense
2.5   Use the future tense
2.6   Identify and use adjectives
2.7   Identify and use adverbs
2.8   Use prepositions
2.9   Use linkers
2.10   State basic sentence structures
2.11   Construct different types of sentences
2.12   Frame questions to elicit information
2.13   Frame questions for confirmation
2.14   Use active voice
2.15   Use passive voice
2.16   Use direct speech
2.17   Use indirect speech
2.18   Identify and correct errors

3.0   Read and comprehend English
3.1   Identify the main ideas
3.2   Identify the specific details
3.3   Draw inferences
3.4   Give contextual meanings of the words
3.5   Perceive tone in a text

4.0   Learn to excel in various forms of written communication (writing composition and data interpretation)
4.1   Identify components of a good paragraph
4.2   Write types of paragraphs
4.3   Distinguish between formal and informal letters
4.4   Write personal letters
4.5   Write leave letters
4.6   Write official letters
4.7   Write letters of complaints
4.8   Prepare a resume
4.9   Write a cover letter
4.10   Write short messages
4.11   Report incidents
4.12   Report experiments
4.13   Report Industrial visits
4.14   Write work done statements
4.15   Write maintenance reports
4.16   Make notes using Cue method and Mapping method
4.17   Summarize Paragraphs
4.18   Present and Interpret Data from flow charts, tree diagrams, bar graphs, tables, pie charts

Practice spoken communication suited to various situations.
4.19   Use appropriate expressions to greet and take leave
4.20   Use proper expressions to make requests
4.21   Use apt expressions for asking and giving directions
4.22   Use suitable expressions to seek and offer suggestions
4.23   Use suitable expressions to state intentions

4.24   Use suitable expressions to state feelings
4.25   Use appropriate expressions to state agreement and disagreement
4.26   Use proper expressions to make complaints
4.27   Use suitable expressions to express obligations

Course Material
The textbook prepared by the faculty of English of Polytechnics in AP.

Reference Books
1. Essential English Grammar (Intermediate Level)   Raymond Murphy
2. Learn English (A Fun Book of Functional Language,   Santanu Sinha Chaudhuri
            Grammar and Vocabulary)
3. Grammar Builder (Entire Series)   Oxford University Press
4. High School English Grammar (Revised Edition)   Wren and Martin
5. Sentence skills with Readings   John Langan, Paul Langan
            (fourth Edition, Tata McGraw Hill)

6. Word Power Made Easy   Norman Lewis
7. Spoken English   Shashi Kumar and Dhamija

Engineering Mathematics - I

(Common to all Branches)

Subject Title	: **Engineering Mathematics - I**
Subject Code	: Common- 102
Periods per Week	: 5
Periods per Year	: 150

Time Schedule

S. No	Major Topic	No of Periods		Weightage of Marks	Short Type			Essay Type		
	Unit - I : Algebra	**Theory**	**Practice**		**R**	**U**	**App**	**R**	**U**	**App**
1	Logarithms	3	0	0	0	0	0	0	0	0
2	Partial Fractions	5	0	3	0	1	0	0	0	0
3	Matrices and Determinants	10	10	16	2	0	0	0	0	1
	Unit - II : Trigonometry									
4	Trigonometric Ratios	2	0	0	0	0	0	0	0	0
5	Compound Angles	3	2	3	1	0	0	0	0	0
6	Multiple and Submultiple angles	4	4	3	0	1	0	0	0	0
7	Transformations	4	4	5	0	0	0	1/2	0	0
8	Inverse Trigonometric Functions	3	2	5	0	0	0	0	1/2	0
9	Trigonometric Equations	3	2	5	0	0	0	1/2	0	0
10	Properties and solutions of triangles	4	4	5	0	0	0	0	0	1/2
11	Hyperbolic Functions	2	0	0	0	0	0	0	0	0
12	Complex Numbers	4	2	3	1	0	0	0	0	0
	Unit III : Co-ordinate Geometry									
13	Straight Lines	5	3	6	1	1	0	0	0	0
14	Circle	4	2	5	0	0	0	0	1/2	0
15	Conic Sections	4	3	5	0	0	0	0	1/2	0
	Unit – IV : Differential Calculus									

S. No	Major Topic	No of Periods Theory	Practice	Weightage of Marks	Short Type R	U	App	Essay Type R	U	App
16	Limits and Continuity	4	2	3	0	1	0	0	0	0
17	Differentiation	18	10	23	1	0	0	1	1	0

S. No	Major Topic	No of Periods		Weightage of Marks	Short Type			Essay Type		
	Unit - V : Applications of Differentiation	Theory	Practice		R	U	App	R	U	App
18	Geometrical Applications	3	2	5	0	0	0	0	0	1/2
19	Physical Applications	2	2	5	0	0	0	0	0	1/2
20	Maxima and Minima	3	4	5	0	0	0	0	0	1/2
21	Errors and Approximations	2	0	5	0	0	0	0	0	1/2
	Total	92	58	110	6	4	0	2	2 1/2	3 1/2
				Marks	18	12	0	20	25	35

R: **Remembering type** 38 marks

U: **Understanding type** 37 marks

App: **Application type** 35 marks

ENGINEERING MATHEMATICS – I
COMMON TO ALL BRANCHES – 102

Objectives
Upon completion of the course the student shall be able to:
UNIT – I

Algebra

1.0   Use Logarithms in engineering calculations

   1.1   Define logarithm and list its properties.

   1.2   Distinguish natural logarithms and common logarithms.

   1.3   Explain the meaning of e and exponential function.

   1.4   State logarithm as a function and its graphical representation.

   1.5   Use the logarithms in engineering calculations.

2.0   Resolve Rational Fraction into sum of Partial Fractions in engineering problems

   2.1   Define the following fractions of polynomials:

   1.   Rational,

   2.   Proper and

   3.   Improper

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

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

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

3.0   Use Matrices for solving engineering problems

   3.1   Define a matrix and order of a matrix.

   3.2   State various types of matrices with examples (upto 3rd order square matrices).

   3.3   Compute sum, scalar multiplication and product of matrices.

   3.4   Illustrate the properties of these operations such as associative, distributive, commutative properties with examples and counter examples.

   3.5   Define the transpose of a matrix and write its properties.

   3.6   Define symmetric and skew-symmetric matrices.

   3.7   Resolve a square matrix into a sum of symmetric and skew- symmetric matrices with examples in all cases.

   3.8   Define minor, co-factor of an element of 2X2 and 3x3 square matrices with examples.

   3.9   Expand the determinant of a 3 x 3 matrix using Laplace expansion formula.

   3.10   Distinguish singular and non-singular matrices.

   3.11   State properties of determinants with simple examples.

3.12   Define multiplicative inverse of a matrix and list properties of adjoint and inverse.

3.13   Compute adjoint and multiplicative inverse of a square matrix.

3.14   Representation of system of linear equations (2 variables in 2 equations and 3 variables in 3 equations) in matrix form.

3.15   Solve system of linear equations using Cramer's rule.

3.16   Solve system of linear equations by matrix inversion method

3.17   State elementary row operations.

3.18   Solve a system of linear equations by Gauss- Jordan method

UNIT – II

Trigonometry :

4.0   Understand Trigonometric Ratios

4.1   Define trigonometric ratios of any angle.

4.2   List the values of trigonometric ratios at specified values.

4.3   Draw graphs of trigonometric functions

4.4   Explain periodicity of trigonometric functions.

5.0   Solve simple problems on Compound Angles

5.1   Define compound angles and state the formulae of $\sin(A\pm B)$, $\cos(A\pm B)$, $\tan(A\pm B)$ and $\cot(A\pm B)$

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

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

5.4   Solve simple problems on compound angles.

6.0   Solve problems using the formulae for Multiple and Sub- multiple Angles

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

6.2   Derive useful allied formulas like sinA= (1- cos2A)/2 etc.,

6.3   Solve simple problems using the above formulae

7.0   Apply Transformations for solving the problems in Trigonometry

7.1   Derive the formulae on transforming sum or difference of two trigonometric ratios in to a product and vice versa- examples on these formulae.

8.0   Use Inverse Trigonometric Functions for solving engineering problems

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

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

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

8.4   State various properties of inverse trigonometric functions and identities like sin^{-1}x+cos^{-1} x = $\dfrac{\pi}{2}$ etc.

8.5   Derive formulae like $\tan^{-1} x + \tan^{-1} y = \tan^{-1}\left(\dfrac{x+y}{1-xy}\right), \ where \ x \geq 0, y \geq 0, xy < 1$ etc., and solve simple problems.

9.0   Solve Trigonometric Equations in engineering applications

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

9.2   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.

10.0   Appreciate Properties of triangles and their solutions

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

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

10.3   List various formulae for the area of a triangle.

10.4   Solve problems using the above formulae.

10.5   Solve a triangle when (i) three sides, (ii) two sides and an included angle, (iii) two sides and an opposite angle-case of two solutions and (iv) one side and two angles are given.

11.0   Represent the Hyperbolic Functions in terms of logarithm functions

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

11.2   Represent inverse hyperbolic functions in terms of logarithms.

12.0   Represent Complex numbers in various forms

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

12.2   Define the operations on complex numbers with examples.

12.3   Define amplitude of a complex number

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

12.5   State DeMoivre's theorem and its applications to complex numbers e.g., finding the roots, powers, simplifications of a complex number with illustrative examples

UNIT - III

Coordinate Geometry

13.0   Solve the problems on Straight lines

13.1   Write the different forms of a straight line – point slope form, two point form, intercept form, normal form and general form

13.2   Solve simple problems on the above forms

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

14.0   Solve the problems on Circles

14.1   Define locus of a point – circle and its equation.

14.2   Find the equation of a circle given

(i)   Center and radius

(ii)   Two ends of a diameter

(iii)   Centre and a point on the circumference

(iv)   Three non collinear points

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

15.0   Appreciate the properties of Conics in engineering applications

15.1   Define a conic section.

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

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

15.4   Describe the properties of Parabola, Ellipse and Hyperbola in standard form.

UNIT - IV

Differential Calculus

16.0   Use the concepts of Limit and Continuity for solving the problems

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

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

$\lim\limits_{x \to 0} (1 + x)^{\frac{1}{x}}$, $\lim\limits_{x \to \infty} \left(1 + \dfrac{1}{x} \right)^x$ (All without proof).

16.3   Solve the problems using the above standard limits

16.4   Evaluate the limits of the type $\lim\limits_{x \to l} \dfrac{a x^2 + b x + c}{\alpha x^2 + \beta x + \gamma}$ and $\lim\limits_{x \to \infty} \dfrac{f(x)}{g(x)}$

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

17.0   Appreciate Differentiation and its meaning in engineering situations

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

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

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

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

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

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

17.6   Explain the method of differentiation of a function of a function (Chain rule) with illustrative examples such as

      (i) $\sqrt{t^2 + \dfrac{2}{t}}$ **(ii)** $x^2 \sin 2x$ **(iii)** $\dfrac{x}{\sqrt{x^2 + 1}}$ **(iv)** $\log\left(\sin(\cos x)\right)$.

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

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

17.9   Find the derivatives of hyperbolic functions.

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

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

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

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

17.14   Explain the definition of Homogenous function of degree n

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

UNIT - V

Applications of the Differentiation

18.0   Understand the Geometrical Applications of Derivatives

18.1   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.

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

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

18.4   Explain the concept of angle between two curves and procedure for finding the angle between two given curves with illustrative examples.

19.0   Understand the Physical Applications of Derivatives

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

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

20.0   Use Derivatives to find extreme values of functions

20.1   Define the concept of increasing and decreasing functions.

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

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

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

21.0   Use Derivatives to find Errors and Approximations

21.1   Find the absolute error, approximate error, relative error and percentage error in functions of single variable.

COURSE CONTENT

Unit-I

Algebra

1. Logarithms :

   Definition of logarithm and its properties, natural and common logarithms; the meaning of e and exponential function, logarithm as a function and its graphical representation.

2. Partial Fractions :

   Rational, proper and improper fractions of polynomials. Resolving rational fractions in to their partial fractions covering the types mentioned below:

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

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

Matrices:

3. Definition of matrix, types of matrices-examples, algebra of matrices-equality of two matrices, sum, scalar multiplication and product of matrices. Transpose of a matrix-Symmetric, skew symmetric matrices-Minor, cofactor of an element-Determinant of a square matrix-Laplace's expansion, properties of determinants. Singular and non singular matrices-Adjoint and multiplicative inverse of a square matrix- examples-System of linear equations in 2 or 3 variables-Solutions by Cramer's rule, Matrix inversion method-examples-Elementary row operations on matrices -Gauss-Jordan method to solve a system of equations.

Unit-II

Trigonometry :

4. Trigonometric ratios: definition of trigonometric ratios of any angle, values of trigonometric ratios at specified values, draw graphs of trigonometric functions, periodicity of trigonometric functions.

5. Compound angles: Formulas of sin(A±B), cos(A±B), tan(A±B),cot(A±B),and related identities with problems.

6. Multiple and sub multiple angles: trigonometric ratios of multiple angles 2A,3A and submultiple angle A/2 with problems.

7. Transformations of products into sums or differences and vice versa simple problems

8. Inverse trigonometric functions : definition, domains and ranges-basic properties- problems.

9. Trigonometric equations: concept of a solution, principal value and general solution of trigonometric equations :

   sin x =k , cos x= k, tan x =k.

Solutions of simple quadratic equations, equations involving usage of transformations- problems.

10. 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.

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

12. Complex Numbers: Definition of a complex number, Modulus and conjugate of a complex number, Arithmetic operations on complex numbers, Modulus- Amplitude (polar) form, Exponential form (Euler) form of a complex number- Problems. DeMoivre's Theorem and its applications in complex numbers- Simple problems.

UNIT-III

Coordinate geometry

13. Straight lines: various forms of straight lines, angle between lines, perpendicular distance from a point, distance between parallel lines-examples.

14. Circle: locus of a point, Circle definition-Circle equation given (i) center and radius, (ii) two ends of a diameter (iii) centre and a point on the circumference (iv) three non collinear points - general equation of a circle - finding center, radius.

15. Definition of a conic section, equation of a conic when focus directrix and eccentricity are given. Properties of parabola, ellipse and hyperbola, standard forms.

UNIT-IV

Differential Calculus

16. Concept of Limit- Definition- Properties of Limits and Standard Limits -Simple Problems-Continuity of a function at a point- Simple Examples only.

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

UNIT-V

Applications of Derivatives:

18. Geometrical meaning of the derivative, equations of Tangent and normal to a curve at any point. Lengths of tangent, normal, sub tangent and subnormal to the curve at any point. Angle between the curves - problems.

19. Physical applications of the derivative – velocity, acceleration, derivative as a rate Measure – Problems.

20. Applications of the derivative to find the extreme values – Increasing and decreasing functions, finding the maxima and minima of simple functions - problems leading to applications of maxima and minima.

21. Applications of derivative in finding errors and approximations of functions and simple problems.

Reference Books :

1. A text book of matrices by Shanti Narayan,
2. Plane Trigonometry, by S.L Loney
3. Co-ordinate Geometry, by S.L Loney
4. Thomas Calculus, Pearson Addison-Wesley publishers
5. Calculus – I, by Shanti Narayan and Manicavachgam Pillai, S.V Publications

ENGINEERING PHYSICS

Subject Title : **Engineering Physics**
Subject Code : **Common -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	12	13	1	1
3.	Kinematics	14	13	1	1
4.	Friction	08	10	-	1
5.	Work, Power and Energy	12	10	-	1
6.	Simple Harmonic Motion	12	13	1	1
7.	Heat & Thermodynamics	12	13	1	1
8.	Sound	12	13	1	1
9.	Properties of matter	10	06	2	-
10.	Electricity & magnetism	12	13	1	1
11.	Modern Physics	08	03	1	-
	Total:	**120**	**110**	**10**	**8**

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

1.0 Understand the concept of Units and dimensions
    1.1 Explain the concept of Units
    1.2 Define the terms
        a) Physical quantity, b) Fundamental physical quantities and
        c) 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 State Rules of writing S.I. units
    1.8 State advantages of SI units
    1.9 Define Dimensions
    1.10 Write Dimensional formulae
    1.11 Derive dimensional formulae of physical quantities
    1.12 List dimensional constants and dimensionless quantities
    1.13 State the principle of Homogeneity of Dimensions
    1.14 State the applications of Dimensional analysis
    1.15 State the limitations of dimensional analysis
    1.16 Solve problems

2.0 Understand the concept of Elements of Vectors
    2.1 Explain the concept of Vectors
    2.2 Define Scalar and Vector quantities
    2.3 Give examples for scalar and vector quantities
    2.4 Represent vectors graphically
    2.5 Classify the Vectors
    2.6 Resolve the vectors

2.7   Determine the Resultant of a vector by component method
2.8   Represent a vector in space using unit vectors (I, j, k)
2.9   State triangle law of addition of vectors
2.10   State parallelogram law of addition of vectors
2.11   Illustrate parallelogram law of vectors in case of flying bird and sling.
2.12   Derive expression for magnitude and direction of resultant of two vectors
2.13   State polygon law of addition of vectors
2.14   Explain subtraction of vectors
2.15   Define Dot product of two vectors with examples (Work done, Power)
2.16   Mention the properties of Dot product
2.17   Define Cross products of two vectors with examples (Torque, Linear velocity)
2.18   Mention the properties of Cross product.
2.19   Solve the related numerical problems

3.0   Understand the concept of Kinematics
3.1   Write the equations of motion in a straight line
3.2   Explain the acceleration due to gravity
3.3   Derive expressions for vertical motion
        a) Maximum Height, b) time of ascent, c) time of descent, and d) time of flight
3.4   Derive height of a tower when a body projected vertically upwards from the top of
        a tower.
3.5   Explain projectile motion with examples
3.6   Explain Horizontal projection
3.7   Derive an expression for the path of a projectile in horizontal projection
3.8   Explain oblique projection
3.9   Derive an expression for the path of projectile in oblique projection
3.10   Derive formulae for projectile in oblique projection
        a) Maximum Height, b) time of ascent, c) time of descent, and d) time of flight
        e) Horizontal Range, f) Maximum range
3.11   Solve the related numerical problems

4.0   Understand the concept of Friction
4.1   Define friction
4.2   Classify the types of friction and define
4.3   Explain the concept of Normal reaction
4.4   State the laws of friction
4.5   Define coefficients of friction
4.6   Explain the Angle of friction
4.7   Derive an expression for acceleration of a body on a rough horizontal surface
4.8   Derive an expression for the displacement and time taken to come to rest over a
        rough horizontal surface
4.9   Define Angle of repose
4.10   Derive expressions for acceleration of a body on a smooth inclined plane (up
        and down)
4.11   Derive expressions for acceleration of a body on a rough inclined plane (up
        and down)
4.12   List the Advantages and Disadvantages of friction
4.13   Mention the methods of minimizing friction
4.14   Solve the related numerical problems

5.0   Understand the concepts of Work, Power, and Energy
5.1   Define the terms 1.Work, 2. Power and Energy
5.2   State SI units and dimensional formulae for 1.Work, 2. Power, and Energy
5.3   Define potential energy and state examples
5.4   Derive the expression for Potential energy
5.5   Define kinetic energy and state examples

5.6   Derive the expression for kinetic energy

5.7   State and derive Work- Energy theorem

5.8   Derive the relation between Kinetic energy and momentum

5.9   State the law of conservation of energy and mention examples

5.10   Verify the law of conservation of energy in the cases of a freely falling body and vertically projected body in the upward direction

5.11   Solve the related numerical problems

6.0   Understand the concept of Simple harmonic motion

6.1   Define Simple harmonic motion

6.2   Give examples for Simple harmonic motion

6.3   State the conditions of Simple harmonic motion

6.4   Explanation of SHM in terms of projection of circular motion on any one of the diameters of the circular path

6.5   Derive expression for displacement

6.6   Derive expression for velocity

6.7   Derive expression for acceleration

6.8   Derive expression for Time period and frequency of S H M

6.9   Define phase of S H M and explain from the expression of displacement

6.10   Define Ideal simple pendulum and derive expression for Time period of simple pendulum

6.11   State the laws of motion of simple pendulum and mention formulae

6.12   Solve the related numerical problems

7.0   Understand the concept of Heat and thermodynamics

7.1   Explain the concept of expansion of gases

7.2   State and explain Boyle's law and also express it in terms of density

7.3   Define absolute zero temperature

7.4   Explain absolute scale of temperature

7.5   State Charles laws in terms of absolute temperature and explain

7.6   Define ideal gas and distinguish from real gas

7.7   Derive Ideal gas equation

7.8   Define Specific gas constant and Universal gas constant

7.9   Explain why universal gas constant is same for all gases

7.10   State SI unit and dimensional formula of universal gas constant

7.11   Calculate the value of universal gas constant

7.12   State the gas equation in different forms (as a function of density and mass)

7.13   Distinguish between r and R

7.14   State and Explain Isothermal process

7.15   State and Explain adiabatic process

7.16   Distinguish between isothermal and adiabatic processes

7.17   State first and second laws of thermodynamics and state applications

7.18   Define specific heats & molar specific heats of a gas and differentiate them

7.19   Derive the relation $C_p - C_v = R$ (Mayer's Equation)

7.20   Solve the relavent numerical problems

8.0   Understand the concept of Sound

8.1   Define the term sound

8.2   Explain longitudinal and transverse wave motion and state differences

8.3   Distinguish between musical sound and noise

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

8.5   Explain causes of noise pollution

8.6   Explain effects of noise pollution

8.7   Explain methods of minimizing noise pollution

8.8   Explain the phenomenon of beats

8.9   State the applications of beats

8.10   Define Doppler effect
8.11   List the Applications of Doppler effect
8.12   Define reverberation and reverberation time
8.13   Write Sabine's formula and name the parameters contained
8.14   Define and Explain echoes and also state its applications
8.15   State conditions of good auditorium
8.16   Solve the related numerical problems

9.0   Understand the properties of matter
9.1   Define the term Elasticity
9.2   Define the terms stress and strain and also define different types of stress and   strain
9.3   State the units and dimensional formulae for stress and strain
9.4   State and explain Hooke's law
9.5   Define surface tension and state examples
9.6   Explain Surface tension with reference to molecular theory
9.7   Define angle of contact
9.8   Define capillarity
9.9   Write the formula for surface tension based on capillarity and name the parameters
9.10   Explain the concept of Viscosity
9.11   Mention examples of Viscosity
9.12   State Newton's formula for viscous force and explain
9.13   Define co-efficient of viscosity and write its units and dimensional formula
9.14   Explain the effect of temperature on viscosity of liquids and gases
9.15   State Poiseulle's equation for Co-efficient of viscosity and name the physical quantities involved
9.16   Solve the related numerical problems

10.0   Understand the concept of Electricity and Magnetism
10.1   Explain the concept of Electricity
10.2   State Ohm's law and write the formula
10.3   Explain Ohm's law
10.4   Define specific resistance, conductance and state their units
10.5   State Kichoff's laws
10.6   Explain Kichoff's laws
10.7   Describe Wheatstone's bridge with legible sketch
10.8   Derive an expression for balancing condition of Wheatstone's bridge
10.9   Describe Meter Bridge experiment for the determination of resistivity with a neat circuit diagram
10.10   Write the formula in Meter Bridge to determine specific resistance
10.11   Explain the concept of magnetism
10.12   State the Coulomb's inverse square law of magnetism
10.13   Define magnetic field and magnetic lines of force and write the properties of magnetic lines of force
10.14   State the Magnetic induction field strength and mention its units and dimensionsal formula
 10.15 Derive an expression for the moment of couple on a bar magnet placed in a uniform magnetic field
10.16   Derive Magnetic induction field strength at a point on the axial line
10.17   Derive Magnetic induction field strength at a point on the equatorial line
10.18   Solve the related numerical problems

11.0   Understand the concept of Modern physics
11.1   State and Explain Photo-electric effect
11.2   Write Einstein's photoelectric equation and explain
11.3   State laws of photoelectric effect

11.4   Explain the Working of photoelectric cell
11.5   List the Applications of photoelectric effect
11.6   Recapitulate refraction of light and its laws
11.7   Define critical angle
11.8   Explain the 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   Define super conductor and superconductivity and mention examples for superconductors
11.13   State the properties of superconducting materials
11.14   List the applications of superconductors

COURSE CONTENT

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

3. **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 - 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- Law of Conservation of energy- Problems

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

7. **Heat and Thermodynamics:**
Expansion of Gases- Boyle's law- Absolute scale of temperature- Charles laws- Ideal gas equation- Universal gas constant- Differences between r and R- Isothermal and adiabatic processes- Laws of thermodynamics- Specific heats - molar specific heats of a gas –Derivation of Mayer's Equation- Problems

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

9. **Properties of matter**
    Definition of Elasticity –Definition of stress and strain -the units and dimensional formulae for stress and strain-The Hooke's law- Definition of surface tension-Explanation of Surface tension with reference to molecular theory - Definition of angle of contact - Definition of capillarity -The formula for surface tension based on capillarity - Explanation of concept of Viscosity - Examples for surface tension and Viscosity - Newton's formula for viscous force- Definition of co-efficient of viscosity- The effect of temperature on viscosity of liquids and gases - Poiseuille's equation for Co-efficient of viscosity- The related numerical problems

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

11. **Modern Physics;**
    Photoelectric effect –Einstein's photoelectric equation-laws of photoelectric effect - photoelectric cell –Applications of photo electric effect- Total internal reflection- fiber optics- -principle and working of an optical fiber-types of optical fibers - Applications of optical fibers- superconductivity - applications

REFERENCE BOOKS

1. Intermediate physics Volume-I & 2	Telugu Academy (English version)
2. Unified physics Volume 1,2,3 and 4	Dr.S.L Guptha and Sanjeev Guptha
3. Text book of physics Volume I	Resnick & Holiday
4. Text book of applied physics	Dhanpath Roy
5. Fibre optics	D.A Hill
6. NCERT Text Books	XI & XII Standard

Blue Print for setting question paper at different levels

S.No	Major Topics	No. of Periods	Weightage of Marks	Short answer type			Essay type		
				K	U	A	K	U	A
1.	Units and Dimensions	08	03	1	0	0	0	0	0
2.	Elements of Vectors	12	13	0	0	1	0	1	0
3.	Kinematics	14	13	0	1	0	1	0	0
4.	Friction	08	10	0	0	0	0	1	0
5.	Work, Power and Energy	12	10	0	0	0	0	1	0
6.	Simple Harmonic Motion	12	13	0	0	1	0	1	0
7.	Heat & Thermodynamics	12	13	0	1	0	1	0	0
8.	Sound	12	13	0	1	0	0	0	1
9.	Properties of Matter	10	06	1	1	0	0	0	0
10.	Electricity & magnetism	12	13	0	1	0	0	1	0
11.	Modern Physics	08	03	1	0	0	0	0	0
	Total:	**120**	**110**	**3**	**5**	**2**	**22**	**5**	**1**

Subject Title : **Engineering Chemistry & Environmental Studies**
Subject Code : **Common-104**
Periods per week : **04**
Total periods per year : **120**

Time Schedule

S.No	Major topic	No of Periods	Weight age of marks	Short type (3marks)			Essay type (10 marks)			remarks
				R	U	A	R	U	A	
A. ENGINEERING CHEMISTRY										
1	Fundamentals of Chemistry	18	16	1	0	1	0	1	0	
2	Solutions	10	8	1	0	0	0	0	1/2	5 mark
3	Acids and bases	10	8	0	0	1	0	1/2	0	5 mark
4	Principles of Metallurgy	10	10	0	0	0	1	0	0	
5	Electrochemistry	14	13	0	1	0	0	0	1	
6	Corrosion	8	10	0	0	0	0	1	0	
7	Water Technology	14	13	1	0	0	1	0	0	
8	Polymers	12	13	1	0	0	1	0	0	
9	Fuels	6	3	1	0	0	0	0	0	
B. ENVIRONMENTALSTUDIES		18	16	1	1	0	0	1	0	
	total	120	110	6	2	2	3	3 1/2	1 1/2	
				18	6	6	30	35	15	

OBJECTIVES

Upon completion of the course the student shall be able to

A.ENGINEERINGCHEMISTRY

1.0 Understand the concept of Atomic structure

1.1 Explain the charge and mass of fundamental particles of an atom (electron, proton and neutron)
1.2 Explain the concept to f atomic number and mass number.
1.3 State the Postulates of Bohr's atomic theory and its limitations.
1.4 Explain the significance of four Quantum numbers.
1.5 Explain 1. Aufbau principle, 2 Pauli's exclusion principle 3 Hund's rule.
1.6 Define Orbital in an atom.
1.7 Draw the shapes of s,pandd - Orbitals .
1.8 Distinguish between Orbit and Orbital
1.9 Write the electronic configuration of elements up to atomic number 30
1.10 Explain the significance of chemical bonding
1.11 Explain the Postulates of Electronic theory of valency

1.12 Define the types of Chemical bonding viz., Ionic, Covalent bonds.
1.13 Explain the types of Chemical bonding viz., Ionic, Covalent bonds with examples.
1.14 Explain bond formation in NaCl and MgO.
1.15 List Properties of Ionic compounds
1.16 Explain bond formation in Hydrogen molecule, Oxygen molecule, and Nitrogen molecule using Lewis dot method.
1.17 List Properties of Covalent compounds
1.18 Distinguish between properties of ionic compounds and covalent compounds.
1.19 Structures of ionic solids-define a) Unit cell b) co-ordination number.
1.20 Structures of Unit cells of NaCl and CsCl.
1.21 Define the term. Oxidation number.
1.22 Calculate the Oxidation Number of underlined atoms in the following examples
a)K$\underline{Mn}$O$_4$ b) K$_2$$\underline{Cr}_2O_7$ c) H$\underline{N}$O$_3$ d) H$_2$$\underline{S}O_4$ e) $\underline{Cl}$O$_4^-$ f) $\underline{N}$H$_4^+$
1.23 Differentiate between Oxidation Number and Valency

2.0   Calculate Molarity and Normality of given Solution
2.1 Define the terms 1.Solution, 2.Soluteand 3.Solvent
2.2 Classify solutions based on physical state and solubility
2.3 Define mole
2.4 Problems on 'Mole concept'
2.5 Define the terms 1. Atomic weight, 2.Molecular weight and 3. Equivalent weight
2.6 Calculate Molecular weight and Equivalent weight of given Acids,(HCl,H$_2$SO$_4$HNO$_3$)Bases (NaOH, KOH, Ca(OH)$_2$) and Salts (NaCl, Na$_2$CO$_3$, CaCO$_3$)
2.7 Define 1.Molarity, 2.Normality of solutions
2.8 Solve Numerical problem son Molarity and Normality
a) calculate the Molarity or Normality if weight of solute and volume of solution are given
b) calculate the weight of solute if Molarity or normality with volume of solution are given
c) problems on dilution to convert high concentrated solutions to low concentrated solutions

3.0   Understand the concepts of Acids and bases
3.1 Explain Arrhenius theory of Acids and Bases
3.2 State the limitations of Arrhenius theory of Acids and Bases
3.3 Explain Bronsted – Lowry theory of acids bases
3.4 State the limitations of Bronsted – Lowry theory of acids bases
3.5 Explain Lewis theory of acids and bases
3.6 State the limitations of Lewis theory of acids and bases
3.7 Explain the Ionic product of water
3.8 Define pH and explain Sorens on scale
3.9 Solve the Numerical problems on pH(Strong Acids and Bases)
3.10 Define Buffer solution
3.11 Give atleast three examples for Buffer solutions
3.12 State the applications of Buffer solution

4.0   Understand the Principles of Metallurgy
4.1 List at least eight Characteristics of Metals
4.2 Distinguish between Metals and Non Metals
4.3 Define the terms 1.Mineral, 2.Ore, 3. Gangue, 4.Fluxand 5.Slag
4.4 Describe the methods of concentration of Ore; 1.Handpicking,2.Levigation, and 3. Froth Floatation
4.5 Describe the methods involved in extraction of crude metal- Roasting, Calcination and   Smelting.
4.6 Explain the purification of Metals by Electrolytic Refining
4.7 Define an Alloy
4.8 Write the Composition of the following alloys:1.Brass, 2. Germansilver,3 Nichrome
4.9 List the uses of the following Alloys: 1. Brass, 2.Germansilver, 3.Nichrome

5.0   Understand the concepts of Electrochemistry
5.1   Define the terms1. Conductor, 2. Insulator, 3.Electrolyte 4.Non–electrolyte
5.2   Distinguish between metallic conduction and Electrolytic conduction
5.3   Explain electrolysis by taking example fused NaCl
5.4   Explain Faraday's laws of electrolysis
5.5   Define 1. Chemical equivalent (E) 2. Electrochemicalequivalent (e) and their relation.
5.6   Solve the Numerical problems based on Faraday's laws of electrolysis
5.7   Define Galvanic cell
5.8   Explain the construction and working of Galvanic cell
5.9   Distinguish between electrolytic cell and galvanic cell
5.10   Explain the electrode potentials and standard electrode potentials
5.11   Explain the electro chemical series and its significance
5.12   Explain the emfofa cell.
5.13   Solve the numerical problems on emfof the cell based on standard electrode potentials.

6.0   Understand the concept of Corrosion
6.1   Define the term corrosion
6.2   state the Factors influencing the rate of corrosion
6.3   Describe the formation of a)composition cell, b)stress cell ,c) concentration cell during corrosion.
6.4   Define rusting of iron and Explain the mechanism of rusting of iron.
6.5   Explain the methods of prevention of corrosion:
       a)Protective coatings (anodic and cathodic coaitings)
       b) Cathodic protection(Sacrificial anode process and Impressed–voltage process)

7. 0   Understand the concept of Water Technology
7.1   State the various Sources of water like Surface water and sub-surface water.
7.2   Define the terms soft water and hard water with respect to soap consumption.
7.3   Define the term hardness of water
7.4   Types of hardness of water 1.Temporary hardness 2. Permanent hardness
7.5   List the salts that causing hardness of water(with Formulae)
7.6   State the disadvantages of using hard water in industries
7.7   Define Degree of hardness, units of hardness(mg/L) or ppm.
7.8   Explain the methods of softening of hard water:a) Ion-Exchange process, b)Permutit process or zeolite process
7.9   Concept of Osmosis and Reverse Osmosis with examples .
7.10   State the applications of Reverse Osmosis.
7.11   State essential qualities of drinking water.

8.0   Understand the concepts of Polymers

8.1   Explain the concept of polymerisation
8.2   Describe the methods of polymerization a) addition polymerization of Ethylene b)condensation polymerization of phenol and formaldehyde(Only flow chart i.e. without chemical equations)
8.3   Define the term plastic
8.4   Classify the plastics with examples
8.5   Distinguish between the rmo and thermo setting plastics
8.6   List the Characteristics of plastics
8.7   State the advantages of plastics over traditional materials
8.8   State the disadvantages of using plastics.
8.9   Explain the methods of preparation of the following plastics:
       1.Polythene, 2. PVC, 3.Teflon, 4. Polystyrene and 5. Urea formaldehyde
8.10   Explain the uses of the following plastics:
       1.Polythene, 2. PVC, 3.Teflon, 4.Polystyrene and 5. Urea formaldehyde
8.11   Define the term natural rubber

8.12   write the structural formula of Natural rubber
8.13   Explain the processing of Natural rubber from latex
8.14   List the Characteristics of natural rubber
8.15   Explain the process of Vulcanization
8.16   List the Characteristics of Vulcanized rubber
8.17   Define the term Elastomer
8.18   Describe the preparation of the following synthetic rubbers a) Buna-s and b)Neo prene rubber
8.19   List the uses of the following synthetic rubbers   a) Buna-s and b)Neo prene rubber

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

B.   ENVIRONMENTALSTUDIES
1.1   Define the term environment
1.2   Explain the scope and importance of environmental studies
1.3   Segments of environment 1).Lithosphere, 2).Hydrosphere, 3).Atmosphere, 4).Biosphere,
1.4   Define the following terms 1)Pollutant, 2).Pollution, 3).Contaminant, 4)receptor, 5)sink, 6) particulates, 7)dissolved oxygen, 8)Threshold limit value, 9).BOD, and 10).COD 11) eco system
1.5   State the renewable and non renewable energy sources with examples.
1.6   Define the terms:
       1).Producers, 2).Consumers and 3).Decomposers with examples.
1.7   Explain bio diversity and threatst obiodiversity
1.8   Define air pollution
1.9   Classify the air pollutants-based on origin and physical state of matter.
1.10   Explain the causes of Air pollution.
1.11   Explain the effects of air pollution on human beings, plants and animals.

1.12   State the uses of forest resources.

1.13   State the deforestation and its causes and effects.

1.14   Explain the 1.) Green house effect , 2) Ozone layer depletion and 3) Acidrain.
1.15   Explain the methods of control of Air pollution
1.16   Define Water pollution
1.17   Explain the causes of Water pollution
1.18   Explain the effects of Water pollution on living and Non-living things.
1.19   Explain the methods of control of Water pollution.

COURSE CONTENT

A.   ENGINEERINGCHEMISTRY
1.   Fundamentals of Chemistry
   Atomic Structure: Introduction - Fundamental particles – Bohr's theory – Quantum numbers – Aufbau principle - Hund's rule - Pauli's exclusion Principle- Orbitals, shapes of s, p and d orbitals - Electronic configurations of elements
   Chemical Bonding: Introduction – types of chemical bonds – Ionic and covalent bond with examples–Properties of Ionic and Covalent compounds- structures of ionic crystals NaCl, CsCl.
   ,**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– pH and related numerical problems– Buffer solutions–Applications.

4. **Principles of Metallurgy**

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

5. **Electrochemistry**

   Conductors, insulators, electrolytes– electrolysis – Faraday's laws of electrolysis- numerical problems – Galvanic cell – standard electrode potential – electrochemical series–emf and numerical problems on emfofa cell

6. **Water technology**

   Introduction–soft and hard water–causes of hardness–types of hardness
   –dis advantages of hard water – degree of hardness (ppm) – softening methods – permut it process – ion exchange process– drinking water –Osmosis, Reverse Osmosis –Applications of Reverse osmosis

7. Introduction - factors influencing 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 – preparationandusesofthefollowingplastics:1.Polythene 2.PVC 3.Teflon 4.Polystyrene 5. Urea formal dehyde – 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-composition and uses of gaseous fuels.

B. **ENVIRONMENTALSTUDIES**

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

REFERENCEBOOKS

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 & Jain
5. Engineering Chemistry   O.P. Agarwal, Hi-Tech.
6. Engineering Chemistry   Sharma
7. Engineering Chemistry   A.K. De

ENGINEERING MECHANICS

Subject Title	:	Engineering Mechanics
Subject Code	:	M-105
Periods/Week	:	04
Periods per year	:	120

Time Schedule

Sno	Major Topics	No. of Periods	Weightage of marks	Short Answer Questions	Essay type Questions
1	Statics	22	21	02	1 ½
2	Friction	18	16	02	01
3	Geometrical properties of sections	22	18	01	1 ½
4	Dynamics	28	26	02	02
5	Simple machines	20	21	02	1 ½
6	Basic Link Mechanisms	10	08	01	½
	Total	**120**	**110**	**10**	**08**

OBJECTIVES

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

1) Understand the concept of Statics
   a) Explain the meaning of mechanics in engineering
   b) State the importance of mechanics in engineering
   c) State the system of units used
   d) Explain the concept of force
   e) List the types of forces
   f) Explain the force systems
      i) Co-planar and Non-coplanar
      ii) Parallel and Non-Parallel
      iii) Like and Unlike
      iv) Concurrent and Non-concurrent
   g) Explain the concept of equilibrium
   h) State the parallelogram law of forces
   i) State the triangle law of forces
   j) State the polygon law of forces
   k) State Lami's theorem
   l) Explain the concept of free body diagram
   m) Solve the problems involving concurrent coplanar forces
   n) Solve simple problems involving non-concurrent coplanar forces
   o) Solve simple problems using Lami's theorem
   p) Define the terms couple and moment of couple
   q) Explain the properties of a couple
   r) State the condition of equilibrium of a body acted upon by co-planarforces

2) Understand the concept of Friction
   a) Explain the concept of friction
   b) State the laws of friction
   c) Identify the machine members in which friction exists
   d) Resolve the forces acting on bodies moving on horizontal plane

e) Resolve the forces acting on bodies moving along the inclined planes
f) Solve the related numerical problems

3) Understand the Geometric Properties of Sections
a) Define the terms centre of gravity, centre of mass and Centroid
b) State the need for finding the Centroid and centre of gravity for various engineering applications
c) Locate the C.G. of a given section
d) Explain the method of determining the Centroid by 'Method of moments'
e) Determine the position of Centroid of standard sections T, L, I, Channel section, Z-section, unsymmetrical I section
f) Determine the position of Centroid of built up sections
g) Explain the meaning of the term moment of Inertia
h) Define the term polar moment of inertia
i) Explain the term radius of gyration
j) State the necessity of finding Moment of Inertia for various engineering applications
k) Determine Moment of Inertia and Radius of gyration for regular geometrical sections like T, L, I, Channel section, Z- section, unsymmetrical I section
l) State Parallel axis theorem and perpendicular axis theorem
m) Determine M.I of standard sections by applying parallel axes theorem
n) Determine M.I of standard sections by applying perpendicular axes theorem
o) Calculate the moment of Inertia of composite sections
p) Calculate radius of gyration of standard sections
q) Determine the polar M.I for solid and hollow circular section applying perpendicular axes theorem
r) Solve the related numerical problems

4) Understand the concept of Dynamics
a) Define the terms Kinematics and Kinetics
b) Classify the motion types
c) Define the terms displacement, velocity and acceleration
d) State the Newton's Laws of motion (without derivation)
e) Solve the problems related to the rectilinear motion of a particle
f) Explain the motion of projectile
g) Solve numerical problems on projectiles
h) State D'Alembert's principle
i) Define the law of conservation of energy
j) Explain the Work-Energy principle
k) Define the law of conservation of momentum
l) Explain the Impulse –momentum equation
m) Solve problems using the above principles
n) Explain the rotary motion of a particle
o) Define centripetal force
p) Define centrifugal force
q) Differentiate between centripetal and centrifugal forces
r) Describe simple harmonic motion
s) Name the Engineering applications of simple harmonic motion

5) Comprehend the Principles involved in Simple Machines
a) Define the important terms of simple machines
   i) Machine
   ii) Mechanical Advantage
   iii) Velocity Ratio
   iv) Efficiency
b) Illustrate the three classes of simple lever
c) Show that an inclined plane is a simple machine to reduce the effort in lifting loads
d) Derive expression for VR in cases of

    i)   Wheel & axle
    ii)   Weston Differential pulley blocks
    iii)   Pulleys
    iv)   Worm & Worm wheel
    v)   Winch crabs
    vi)   Screw jack
    vii)   Rack & pinion

e) Compute the efficiency of a given machine
f) Interpret the law of machine
g) State the conditions for self-locking and reversibility
h) Calculate effort lost in friction and load equivalent of friction
i) Evaluate the conditions for maximum M.A.& Maximum efficiency

6) Understand the concept of Basic Link mechanisms
  a) Define important terms of basic link mechanisms
    i)   Link
    ii)   Kinematic pair
    iii)   Kinematic chain
    iv)   Mechanism, structure & machine
  b) Explain kinematic pair and kinematic chain with the help of sketches
  c) Give examples for Lower and Higher pairs
  d) Give examples of inversion

COURSE CONTENT

  1)   Statics
     The meaning of word mechanics - Application of Mechanics to Engineering - System of Units - Definition and specification of force - System of forces - Resolution of force - Equilibrium and Equilibrant - Statement of Parallelogram law of forces, Triangle law of forces, Polygon law of forces and Lami's theorem - Drawing the free body diagram - Numerical problems related to concurrent coplanar forces - Couple and moment of a couple - Condition for equilibrium of a rigid body subjected to number of coplanar non-concurrent forces - Related Numerical problems

  2)   Friction
     Definition of static friction, dynamic friction and impending friction - Laws of solid and liquid friction - Derivation of limiting angle of friction and angle of repose - Resolution of forces considering friction when a body moves on horizontal plane - Resolution of forces considering friction when a body moves on inclined plane - Numerical examples on the above cases

  3)   Geometric Properties of Sections
     Definition and explanation of the terms centre of gravity, centre of mass and Centroid - Centroid of square, rectangle, triangle, semi-circle and trapezium (formulae only without derivations) - Centre   of gravity of composite sections by analytical method (T-Section, L-Section I-section and channel section only) - Moment of Inertia - Definition and explanation - Theorems of Moment of Inertia - i) Parallel axes theorem ii) Perpendicular axes theorem - Moment of Inertia for simple Geometrical Sections, Rectangular, circular and triangular section - Radius of Gyration   - Calculation of Moment of Inertia and Radius of Gyration of I–Section, Channel Section, T–Section,L–Section (Equal & unequal lengths), Z–section, Built up Sections (Simple cases only)

  4)   Dynamics
     Definition of Kinematics and Kinetics - Classification of motion - Definition of displacement, velocity and acceleration - Newton's Laws of motion (without derivation) - Solving the problems

related to the rectilinear motion of a particle - Motion of projectile and solving the numerical problems - D'Alembert's principle - Law of conservation of energy - Work-Energy principle - Law of conservation of momentum - Impulse–momentum equation - Solving problems using the above principles - Rotary motion of particle - laws of rotary motion - Definition of centripetal and centrifugal forces - differentiation between the two - Simple harmonic motion - Definition of the terms frequency, time period, amplitude and frequency - SHM equation, natural frequency - Simple problems on SHM

5) **Simple Machines**

Definition of simple machine - uses of simple machine - levers   and inclined plane   - Fundamental terms like mechanical advantage, velocity ratio and efficiency- Expressions for VR in case of Simple, Differential and 3 systems of pulleys, Worms and Worm wheel, Rack and pinion, Winch crabs, Screw jack   - Conditions for reversibility and self locking - Law of Simple Machine - Effort lost in friction - Load Equivalent of Friction - Max M A and Max efficiency – Simple problems

6) **Basic Link Mechanism**

Definition and explanation of link, kinematic pair, kinematic chain, Mechanism, structure and machine - Quadric cycle chain and its inversions   - Slider Crank chain and its inversion

REFERENCE BOOKS:

1	Engineering Mechanics	by	Singer (B.S.Publications)
2	Engineering Mechanics	by	Basudeb Bhattacharya (Oxford Publishers)
3	Engineering Mechanics	by	A Nelson(McGraw Hill)
4	Engineering Mechanics	by	I.B.Prasad
5	Engineering Mechanics	by	R.S.Khurmi (S.Chand& Company)
6	Theory of Machines	by	S.S.Rathan (TMH)

WORKSHOP TECHNOLOGY

Subject Title : **Workshop Technology**
Subject Code : **M - 106**
Periods/Week : **04**
Periods per Year : **120**

Time Schedule

Sno	Major Topics	No. of Periods	Weightage of marks	Short Answer Questions	Essay type Questions
1.	Basic Workshop tools & Operations				
	(a) Carpentry	16	13	1	1
	(b) Fitting	18	16	2	1
	(c) Forging	18	16	2	1
	(d) Tin Smithy	16	13	1	1
2.	Foundry	18	16	2	1
3.	Drilling	8	10	-	1
4.	Sawing	8	10	-	1
5.	Mechanical Working of Metals	18	16	2	1
	Total	**120**	**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 & Operations

   a) **Carpentry**
   - i) Identify various carpentry tools
   - ii) Illustrate various carpentry tools
   - iii) State the specifications and applications of a given tool
   - iv) Describebasic wood working processes
   - v) State the practical applications of carpentry joints
   - vi) Explain the working principle of wood working lathe,wood planer, belt sander, spindle sander,disc sander, and grinder

   b) **Fitting**
   - i) Identify various fitting tools
   - ii) Illustrate various fitting tools
   - iii) State the specifications and applications of a given tool
   - iv) Describe the working of common precision measuring instruments with a sketch
   - v) Describebasic fitting operations

   c) **Forging**
   - i) Identify various tools used in black-smithy
   - ii) State the specifications and applications of a given tool
   - iii) List out the equipment of a forge shop
   - iv) Describe the important smithy operations
   - v) Explain the principles of machine forging
   - vi) Explain basic machine forging operations
   - vii) Describe a forging press

d) **Sheet Metal**
  i) Identify various tools used in sheet metal work
  ii) State the specifications and applications of a given tool
  iii) Identify the stakes used in sheet metal work
  iv) State the applications of a given stake
  v) Identify various sheet metal joints
  vi) State the practical applications of a given joint
  vii) Describe the sheet metal operations with sketches
  viii) Differentiate between riveting, soldering, & brazing

2) **Foundry**
  a) Appreciate foundry as a manufacturing process
  b) State the advantages of casting over other processes
  c) State the limitations of casting process
  d) List out the various hand moulding tools
  e) State the properties of good moulding sand
  f) List out the types of moulding sands
  g) List out the ingredients of foundry sand
  h) List out the various types of patterns
  i) Explain the various pattern allowances
  j) Identify the colour codes used in foundry
  k) Explain the various moulding methods
  l) State the need of cores
  m) List out the types of cores
  n) Identify the casting defects their causes and possible remedies
  o) State the principle and applications of Die casting,Centrifugal casting, CO_2 process, investment casting

3) **Drilling**
  a) State the principle of drill work
  b) Classify drilling machines
  c) Draw line diagrams of Sensitive & Radial drilling machinesand identify their parts
  d) Describe the functions of each part of a drilling machine
  e) State the specifications of a drilling machine
  f) Illustratea twist drill
  g) State the Nomenclature of a drill bit
  h) List out the functions of the various elements of a twist drill
  i) State the specifications of a twist drill
  j) List out the different operations performed on a drilling machine

4) **Sawing**
  a) Differentiate between hand sawing and machine sawing
  b) Classify sawing machines
  c) Illustrate saw tooth nomenclature
  d) List out the materials used for saw blades
  e) Illustrate Band saw & Reciprocating power hack saw
  f) Describe the working of Band saw & Reciprocating power hack saw

5) **Mechanical working of Metals**
  a) Define mechanical working of metals
  b) Differentiate between cold working and hot working
  c) Illustrate hot rolling, piercing, spinning, extrusion and drawing
  d) State advantages and limitations of hot working
  e) State the effects of Hot working on the properties of the material
  f) Illustrate cold rolling, bending and squeezing operations
  g) State advantages and limitations of cold working
  h) State the effects of Cold working on the properties of the material

COURSE CONTENTS

1) Basic Workshop tools & Operations

   a) **Carpentry**
      i) **Marking & measuring tools:** Scales- rules- fourfold wooden rule- measuring 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
      ii) **Saws**: Ripsaw - cross cut saw - Panel saw - Tenon saw - Dovetail saw - Bow saw - coping saw - compass saw - keyhole saw
      iii) **Chisels**: Firmer chisel - Bevelled edge firmer chisel - Parting chisel - Mortise chisel - inside and outside gouges
      iv) **Planes:** Jack plane - rough plane - smoothing plane - rebate plane - plough plane - router - spoke shave - metal jack plane - special planes
      v) **Boring Tools**: Gimlet - wheel brace -ratchet brace - shell bit -auger - expansive bit - centre bit -countersink bit - drill - reamer
      vi) **Striking tools**: Hammers -Warrington hammer -claw hammer –mallet
      vii) **Holding tools :** Bench vice - bench stop - bench hold fast - sash cramp – G cramp -hand screw
      viii) **Miscellaneous tools:** Rasps and files - scraper - oilstone - glass paper - pincer - screw driver - cabinet screw driver - ratchetscrew driver - saw set
      ix) **Wood working Processes:** Marking - sawing - planning - chiselling - boring - Grooving - Rebating
      x) **Carpentry joints:** Halving joint -mortise and tenon joint -bridle joint -butt joint - dowel joint - tongue & groove joint - screw & slot joint - dovetail joint - corner joint
      xi) **Wood working machines:** Wood working lathe - wood planer-belt sander- spindle sander - disc sander- grinder
   b) **Fitting**
      i) **Chisels:**Flat chisel - cross cut chisel - half round chisel - diamond point chisel - side chisel
      ii) **Files: F**lat file - hand file - square file - pillar file - round file -triangular file - half round file - knife edge file - needle file
      iii) **Scrapers:**Flat - triangular - half round
      iv) **Saws:** Hacksaw - solid frame& adjustable frame -blades
      v) **Drill bits:**Flat drill - straight fluted drill - twist drill - parallel shank& tapered shank types
      vi) **Reamers:** Hand reamer - machine reamer - straight and spiral flute types
      vii) **Taps & dies:** Hand taps - taper tap - plug tap - bottoming tap –solid dies & split dies
      viii) **Hammers:** Ball peen - cross peen - straight peen - soft hammer
      ix) **Holding tools:** Bench vice – legvice - hand vice - pin vice - tool maker's vice - pipe vice
      x) **Marking tools**: Surface plate – vblock -angle plate - try square - scriber - prick punch - centre punch - number punch - letter punch
      xi) **Miscellaneous tools**: Screw drivers - single ended & double endedspanners - box typespanners - adjustable spanners - cutting pliers - nose pliers -Allen keys
      xii) **Checking and measuring instruments:** Outside &inside callipers - spring callipers - odd leg calliper - transfer calliper - dividers - combination square - universal bevel protractor - sine bar - universal surface gauge - engineer's parallels - slip gauges - feeler gauge - angle gauge - radius & template gauge - screw pitch gauge - telescopic gauges - plate & wire gauge - ring and plug gauges - snap gauges - vernier callipers - vernier height gauge - vernier depth gauge - outside & inside micrometer - stick micrometer - depth micrometer - vernier micrometer - screw thread micrometer
      xiii) **Fitting operations:** Chipping - filing - scrapping - grinding - sawing - marking - drilling - reaming - tapping and dieing

c) **Forging**
   i) **Hand tools:** Anvil - swage block - hand hammers - sledge hammers - tongs – chisels - swages - fullers - flatters - set hammer - punch and drift
   ii) **Equipment:** Open and closed hearth furnaces - hand and power blowers - open and stock fire
   iii) **Fuels:** charcoal - coal - oil & gaseous fuels
   iv) **Smith Operations:** Upsetting - drawing down - setting down - punching and drifting - bending - welding - cutting - swaging -Fullering and flattering
   v) **Machine Forging:** Need of machine forging - forging hammers - spring hammers - pneumatic hammers - steam hammers - drop hammers - Hydraulic press
   vi) **Machine forging operations:** - Drawing - upsetting & punching
   vii) Tools used in machine forging

d) **Sheet Metal Work (Tin smithy):**
   i) **Tools : S**teel rule - circumference rule - thickness gauge - sheet metal gauge - straight edge - scriber - divider -trammel points - punches - chisels – hammers - straight snip - double cutting shear - squaring shear - circular shear bench & block shears - pliers (Flat nose and round nose) - grocers and rivet sets - soldering iron
   ii) **Stakes:** Double seaming stake - beak horn stake - bevel edged square stake -hatches stake - needle stake -blow horn stake -hollow mandrel stake
   iii) **Sheet Metal Operations**: *Shearing*: Cutting off – parting – blanking - punching - piercing - notching - slitting - lancing - nibbling and trimming *Bending*: Single bend - double bend - straight flange - edge hem - embossing - beading - double hem or lock seam *Drawing:* Deep drawing - shallow or box drawing *Squeezing:* Sizing - coining - hobbing - ironing - riveting
   iv) **Sheet Metal Joints**: Single hem - double hem & wired edge seam joint - lap seam - grooved seam - single seam - double seam - dovetail seam - burred bottom seam or flanged seam
   v) **Fastening Methods**: Riveting - soldering - brazing & spot welding

2) **Foundry:** Development of foundry as a manufacturing process - advantages and limitations of casting over other manufacturing processes
   a) **Hand moulding tools** : Shovel - riddle - rammers - trowels - slicks - lifter - strike - off bar – spruepin - bellow - swab - gate cutter - mallet - vent rod - draw spike - rapping plate - pouring weight - gagger - clamps - spirit level - moulding boxes - snap box & flash box
   b) **Sands :** Properties of moulding sand - porosity - flow ability - collapsibility - adhesiveness - cohesiveness - refractoriness - types of moulding sand - Green sand - dry sand - loam sand - facing sand - backing sand - parting sand - core sand - system sand
   c) **Pattern making:** Materials such as wood -cast Iron - Aluminium - Brass – Plastics - 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
   d) **Moulding methods**: green sand and dry sand moulding -cement bonded moulding - shell moulding - Ceramic moulding
   e) **Cores**: Need of cores - types of cores
   f) **Defects in castings**: Causes and their remedies
   g) **Special casting processes:** Die Casting - Centrifugal casting - CO_2 process - investment casting

3) **Drilling:**
   a) **Drilling machines:** Sensitive & Radial drilling machines - their constructional detail and specifications
   b) **Drill bits:** Terminology - Geometry of twist drill -functions of drill elements
   c) **Operations**: Drilling - reaming - boring - counter boring - counter sinking - tapping - spot facing - gang drilling

4) **Sawing:** Hand sawing - Power sawing principles
   a) **Metal sawing machines**: Reciprocating saws (vertical and horizontal) saws- Band saws- constructional details and specifications of the above

b) **Metal Saw blades:** Types - Angles of saw teeth set - Saw material

5) **Mechanical working of metals:** Introduction to Hot working and cold working
   a) **Hot working processes:** rolling - types of rolling - two high mills - three high mills - four high mills - Piercing or seamless tubing - drawing or cupping – spinning- extrusion - direct or forward extrusion - indirect or backward extrusion - tube extrusion - impact extrusion Effects of hot working on metals - advantages & limitations of hot working of metals
   b) **Cold working processes**: Rolling – drawing - wire drawing - tube drawing –bending - roll forming - angle bending - spinning - extrusion -squeezing - cold heading - thread rolling – peeningEffects of Cold working on metals - advantages & limitations of cold working

REFERENCE BOOKS

1. Production Technology   by   Jain & Gupta
2. Elementary Workshop Technology   by   HazraChowdary& Bhattacharya
3. Workshop Technology Vol I & II   by   Raghuvamshi
4. Workshop Technology   by   Pakirappa.
5. Workshop Technology   by   N.Krishna Murthy.

ENGINEERING DRAWING

Subject Title	:	**Engineering Drawing**
Subject Code	:	**107 (Common to all Branches)**
Periods/Week	:	**06**
Periods Per Year	:	**180**

Time Schedule

Sno	Major Topics	No. of Periods	Weightage of marks	Short Answer Questions	Essay type Questions
1	Importance of Engineering Drawing	01	-	-	-
2	Engineering Drawing Instruments	05	-	-	-
3	Free hand lettering & Numbering	06	5	1	-
4	Dimensioning Practice	09	5	1	-
5	Geometrical Constructions	21	15	1	1
6	Projection of points, Lines, Planes & Solids	21	10	-	1
7	Auxiliary views	06	5	1	-
8	Sectional views	27	10	-	1
9	Orthographic Projection	33	10	-	1
10	Pictorial drawing	30	10	-	1
11	Development of surfaces	21	10	-	1
	Total	**180**	**80**	**04**	**06**

The course is aimed at developing basic graphic skills so as to enable them to use these skills in preparation of engineering drawings, their reading and interpretation

OBJECTIVES

Upon completion of the subject the student shall be able to

1) Understand the basic concepts of Engineering Drawing
    a) State the importance of drawing as an engineering communication medium
    b) State the necessity of B.I.S. Code of practice for Engineering Drawing
    c) Explain the linkages between Engineering drawing and other subjects of study in diploma course

2) Use of Engineering Drawing Instruments
    a) Select the correct instruments and draw lines of different orientation
    b) Select the correct instruments and draw small and large Circles
    c) Select the correct instruments for measuring distances on the drawing
    d) Use correct grade of pencil for different types of lines, thickness and given function
    e) Select and use appropriate scales for a given application
    f) Identify different drawing sheet sizes as per I.S. and Standard Layouts
    g) Prepare Title block as per B.I.S. Specifications
    h) Identify the steps to be taken to keep the drawing clean and tidy

3) Write Free Hand Lettering and Numbers
   a) Write titles using slanting letters and numerals of 7mm, 10mm and 14mm height
   b) Write titles using vertical letters and numerals of 7mm, 10mm and 14mm height
   c) Select suitable sizes of lettering for different layouts and applications

4) Understand Dimensioning Practice
   a) Define "Dimensioning"
   b) State the need of dimensioning the drawing according to accepted standards
   c) Identify notations of Dimensioning used in dimensioned drawing
   d) Identify the system of placement of dimensions in the given dimensioned drawing
   e) Dimension a given drawing using standard notations and desired system of dimensioning
   f) Dimension standard features applying necessary rules
   g) Arrange dimensions in a desired method for a given drawing
   h) Identify the departures if any made in the given dimensioned drawing with reference to SP-46-1988, and dimension the same correctly

5) Apply Principles of Geometric Constructions
   a) Divide a given line into desired number of equal parts internally
   b) Draw tangent lines and arcs
   c) Use General method to construct any polygon
   d) Explain the importance of conics
   e) Construct ellipse by concentric circles method
   f) Construct parabola by rectangle method
   g) Construct rectangular hyperbola from the given data
   h) Construct involute from the given data
   i) Construct cycloid and helix from the given data
   j) State the applications of the above constructions in engineering practice

6) Apply Principles of Projection of points, lines, planes & solids
   a) Visualize the objects
   b) Explain the I-angle and III-angle projections
   c) Practice the I-angle projections
   d) Draw the projection of a point with respect to reference planes (HP&VP)
   e) Draw the projections of straight lines with respect to two reference planes (cases of lines parallel to one plane and inclined to other plane only)
   f) Draw the projections of planes (cases of planes perpendicular to one plane and inclined to other plane only)
   g) Draw the projections of solids (cases of axis perpendicular to one plane and inclined to other plane only)

7) Understand the need of auxiliary views
   a) State the need of Auxiliary views for a given engineering drawing
   b) Draw the auxiliary views of a given engineering component
   c) Differentiate between auxiliary view and apparent view

8) Appreciate the need of Sectional Views
   a) Explain the need to draw sectional views
   b) Select the section plane for a given component to reveal maximum information
   c) Explain the positions of section plane with respect to reference planes
   d) Differentiate between true shape and apparent shape of section
   e) Draw sectional views and true sections of regular solids discussed in chapter-6 above
   f) Apply principles of hatching

9) Apply principles of orthographic projection
   a) Explain the principles of orthographic projection with simple sketches
   b) Draw the orthographic view of an object from its pictorial drawing

c) Draw the minimum number of views needed to represent a given object fully

10) Prepare pictorial drawings
   a) State the need of pictorial drawings
   b) Differentiate between isometric scale and true scale
   c) Prepare Isometric views for the given orthographic drawings

11) Interpret Development of surfaces of different solids
   a) State the need for preparing development drawing
   b) Prepare development of simple engineering objects (cubes, prisms, cylinders, cones, pyramids) using parallel line and radial line methods
   c) Prepare development of surface of engineering components like trays, funnels, 90^0 elbows & rectangular ducts

COURSE CONTENT
NOTE
   1) B.I.S Specifications should invariably be followed in all the topics.
   2) A-3 Size Drawing Sheets are to be used for all Drawing Practice Exercises.
   3) First Angle Projection is to be followed for all Orthographic projection exercises

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

2) Engineering drawing Instruments
Classification: Basic tools, tools for drawing straight lines, tools for curved lines, tools for measuring distances and special tools like mini drafter & drafting machine – Mention the names under each classification and their brief description -Scales: Recommended scales reduced & enlarged scales- 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

Drawing Plate 1: Consisting of two exercises on use of drawing instruments

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

Drawing plate 2: Consisting of five to six exercises on freehand Lettering & Numbering

4) Dimensioning practice
Purpose of engineering Drawing, Need of B.I.S code in dimensioning -Shape description of an Engineering object - Dimensioning size, Location 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 dimensioning of narrow spaces

Drawing Plate 3: Consisting of 8 exercises on Dimensioning methods and rules

5) Geometric Constructions

Division of a line: to divide a straight line into given number of equal parts internally and it's examples in engineering applications. 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 Construction of polygon: Construction of any regular polygon of given side using general method. Conical Curves: Explanation of Ellipse, Parabola, Hyperbola, as sections of a double cone and loci of a moving point, Eccentricity of above curves – Their Engg. applications viz. Projectiles, reflectors, P-V Diagram of a Hyperbolic process - Construction of ellipse by concentric circles method - Construction of parabola by rectangle method - Construction of rectangular hyperbola - General Curves: Involute, Cycloid and Helix, explanations as locus of a moving point, their engineering applications, viz, Gear tooth profile, screw threads, springs etc. - their construction.

Drawing Plate 4: Consisting of eight exercises on construction of polygons
Drawing Plate 5: Consisting of eight exercises on construction of conics
Drawing Plate 6: Consisting of eight exercises on involute, cycloid and helix

6) Projection of points, lines, planes & solids

Projecting a point on two planes of projection -Projecting a point on three planes of projection - Projection of straight line i) Parallel to both the planes ii) Perpendicular to one of the planes iii) Inclined to one plane and parallel to other plane - Projection of regular planes- i) Plane perpendicular to HP and parallel to VP and vice versa ii) Plane perpendicular to HP and inclined to VP and vice versa - Projection of regular solids with i) Axis perpendicular to one of the planes ii) Axis parallel to VP and inclined to HP and vice versa

Drawing Plate 7: Consisting of eight exercises on projection of points and Lines
Drawing Plate 8: Consisting of eight exercises on projection of planes
Drawing Plate 9: Consisting of eight exercises on projection of solids

7) Auxiliary views

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

Drawing plate 10: Consisting of four exercises on auxiliary views

8) 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) - Hatching – Section of regular solids inclined to one plane and parallel to other plane

Drawing Plate 11: Consisting of six exercises on sections of solids

9) Orthographic Projections

Meaning of orthographic projection -Using a viewing box model – Number of views obtained on the six faces of the box, - Legible sketches of only 3 views for describing object - Concept of front view, top view, and side view, sketching these views for number of engineering 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 mitre 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 12: Consisting of 12 exercises on orthographic projections of engineering objects

10) Pictorial Drawings

Brief description of different types of pictorial drawing viz., Isometric, oblique, and perspective and their use - 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 view and Isometric projection - Isometric and Non-isometric lines - Isometric drawing of common features like rectangles, circular shapes, non-isometric lines - Use of box and offset methods

Drawing plate 13: Consisting of 12 exercises on Isometric views of engineering objects

11) Development of Surfaces

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

Drawing plate 14: Consisting of 5 exercises on development problems

REFERENCE BOOKS

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

BASIC WORKSHOP PRACTICE

Subject Title	:	**Basic Workshop Practice**
Subject Code	:	**M -108**
Periods/Week	:	**06**
Periods per Year	:	**180**

Time Schedule

S.No	Major Title	No of Periods
1.	Fitting shop	36
2.	Forging shop	39
3.	Carpentry shop	51
4.	Sheet metal work	51
	Test	03
	Total	**180**

OBJECTIVES
Upon completion of the course the student shall be able to
1) Practice the required operations in Fitting Shop
2) Practice the required operations in Forging Shop
3) Practice the required operations in Carpentry Shop
4) Practice the required operations in Sheet metal Shop

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

2) FORGING SHOP
   a) Conversion of round to square
   b) Conversion of round to Hexagon
   c) Preparation of chisel from round rod
   d) Preparation of ring and hook from M.S. round
   e) Preparation of a hexagonal bolt and nut

3) CARPENTRY SHOP
   a) Cutting of wood with hand saw
   b) Planning of wood
   c) Planning and chiselling of wood, orientation of wood grain
   d) Preparation of dovetail joint
   e) Mortise and tenon joint
   f) Wood turning on a lathe
   g) Preparation of one household article

4) SHEET METAL WORK
   a) Cutting Practice on cutting of sheet
   b) Formation of joints like grooved joints, locked groove joint
   c) Preparation of a rectangular open type tray
   d) Preparation of hollow cylinder
   e) Preparation of pipe elbow
   f) Preparation of mug
   g) Preparation of funnel
   h) Preparation of utility articles such as dustpan, kerosene hand pump.

REFERENCE BOOKS

1.   Manufacturing Technology (Vol I)   by   P N Rao (McGraw Hill)
2.   Principles of Foundry Technology   by   P L Jain (McGraw Hill)

PHYSICS LABORATORY

Subject Title	:	Physics Laboratoy	
Subject Code	:	Common -109	
Periods per week	:	03	
Total periods per year	:	45	

TIME SCHEDULE

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

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

Competencies and Key competencies to be achieved by the student

Name of the Experiment (No of Periods)	Competencies	Key competencies
1. Hands on practice on Vernier Calipers(03)	- Find the Least count - Fix the specimen in posit - Read the scales - Calculate the physical quantities of given object	- Read the scales - Calculate the requisite physical quantities of given objects
2. Hands on practice on Screw gauge(03)	- Find the Least count - Fix the specimen in posit - Read the scales - Calculate thickness of glass place and cross section of wire and other quantities	- Read the scales - Calculate thickness of given glass plate - Calculate cross section of wire and other quantities
3. Verification of Parallelogram law of forces and Triangle law of forces(03)	- Fix suitable weights - Note the positions of threads on drawing sheet - Find the angle at equilibrium point - Construct parallelogram - Compare the measured diagonal - Construct triangle - Find the length of sides - Compare the ratios	- Find the angle at equilibrium point - Constructing parallelogram - Construct triangle - Compare the ratios of force and length
4. Simple pendulum(03)	- Fix the simple pendulum to the stand - Adjust the length of pendulum - Find the time for number of oscillations - Find the time period - Calculate the acceleration due to gravity - Draw l-T and l-T^2 graph	- Find the time for number of oscillations - Find the time period - Calculate the acceleration due to gravity - Draw l-T and l-T^2 graph

Name of the Experiment(Periods)	Competencies	Key competencies
5. Velocity of sound in air –Resonance method (03)	• Arrange the resonance apparatus • Adjust the reservoir level for booming sound • Find the first and second resonanting lengths • Calculate velocity of sound	• Adjust the reservoir level • Find the first and second resonanting lengths • Calculate velocity of sound at room temperature • Calculate velocity of sound at 0^0 C
6. Focal length and Focal power of convex lens (Separate & Combination) (03)	• Fix the object distance • Find the Image distance • Calculate the focal length and power of convex lens and combination of convex lenses • Draw u-v and 1/u – 1/v graphs	• Calculate the focal length and power of convex lens • Draw u-v and 1/u – 1/v graphs
7. Refractive index of solid using traveling microscope(03)	• Find the least count of vernier on microscope • Place the graph paper below microscope • Read the scale • Calculate the refractive index of glass slab	• Read the scale • Calculate the refractive index of glass slab
8. Surface tension of liquid using traveling microscope(03)	• Find the least count of vernier on microscope • Focus the microscope to the lower meniscus & bent pin • Read the scale • Calculate height of liquid rise • Calculate the surface tension of water	• Read the scale • Calculate height of liquid rise • Calculate the surface tension of water

Name of the Experiment	Competencies	Key competencies
9. Coefficient of viscosity by capillary method(03)	- Find the least count of vernier - Fix the capillary tube to aspiratory bottle - Find the mass of collected water - Find the pressure head - Calculate rate of volume of liquid collected - Find the radius of capillary tube - Calculate the viscosity of water using capillary method	- Find the pressure head - Calculate rate of volume of liquid collected - Find the radius of capillary tube - Calculate the viscosity of water
10. Boyle's law verification (03)	- Note the atmospheric pressure - Fix the quill tube to retort stand - Find the length of air column - Find the pressure of enclosed air - Find and compare the calculated value P x l	- Find the length of air column - Find the pressure of enclosed air - Find the value P x l
11. Meter bridge(03)	- Make the circuit connections - Find the balancing length - Calculate unknown resistance - Find the radius of wire - Calculate the specific resistance	- Find the balancing length - Calculate unknown resistance - Calculate the specific resistance
12. Mapping of magnet lines of force(03)	- Draw magnetic meridian - Placed the bar magnet in NN and NS directions - Draw magnetic lines of force - Locate the neutral points along equatorial and axial lines	- Draw magnetic lines of force - Locate the neutral points along equatorial and axial lines

CHEMISTRY LABORATORY

Subject Title : **Chemistry Laboratory**
Subject Code : **Common -110**
Periods per week : **03**
Total periods per year : **45**

TIME SCHEDULE

S.No	Name of the Experiment	No. of Periods
1.	Familiarization of methods for Volumetric analysis	03
2.	Preparation of Std $Na_2 CO_3$ and making solutions of different dilution solution.	03
3.	Estimation of HCl solution using Std. $Na_2 CO_3$ solution	03
4.	Estimation of NaOH using Std. HCl solution	03
5.	Estimation of H_2SO_4 using Std. NaOH solution	03
6.	Estimation of Mohr's Salt using Std. $KMnO_4$	03
7.	Determination of acidity of water sample	03
8.	Determination of alkalinity of water sample	03
9.	Determination of total hardness of water using Std. EDTA solution	03
10.	Estimation of Chlorides present in water sample	03
11.	Estimation of Dissolved Oxygen (D.O) in water sample	03
12.	Determination of pH using pH meter	03
13.	Determination of conductivity of water and adjusting ionic strength required level	03
14.	Determination of turbidity of water	03
15.	Estimation of total solids present in water sample	03
	Total:	**45**

Objectives:

Upon completion of the course the student shall be able to

1.0   Practice volumetric measurements (using pipettes, measuring jars, volumetric flask, burettes) and gravimetric measurements (using different types of balances), making dilutions, etc.
2.0   Practice making standard solutions with pre weighed salts and to make solutions of desired dilutions using appropriate techniques.
3.0   Conduct titrations adopting standard procedures and using Std. $Na_2 CO_3$ solution for estimation of HCl
4.0   Conduct titrations adopting standard procedures and using Std. HCl solution for estimation of NaOH
5.0   Conduct titrations adopting standard procedures and using Std. NaOH solution for estimation of H_2SO_4
6.0   Conduct titrations adopting standard procedures and using Std. $KMnO_4$ solution for estimation of Mohr's Salt
7.0   Conduct titrations adopting standard procedures to determine the acidity of given samples of water (One ground water and one surface / tap water, and rain water if available)

8.0   Conduct titrations adopting standard procedures to determine the alkalinity of given samples of water (One ground water and one surface / tap water)
9.0   Conduct titrations adopting standard procedures to determine the total hardness of given samples of water (One ground water and one surface / tap water) using Std. EDTA solution
10.0   Conduct titrations adopting standard procedures to determine the chlorides present in the given samples of water and wastewater (One ground water and one surface / tap water)
11.0   Conduct the test using titrometric / electrometric method to determine Dissolved Oxygen (D.O) in given water samples (One sample from closed container and one from open container / tap water)
12.0   Conduct the test on given samples of water / solutions (like soft drinks, sewage, etc.) to determine their pH using standard pH meter
13.0   Conduct the test on given samples of water / solutions
       a)   To determine conductivity
       b)   To adjust the ionic strength of the sample to the desired value
14.0   Conduct the test on given samples of solutions (coloured and non coloured) to determine their turbidity in NTU
15.0   Conduct titrations adopting standard procedures to determine the total solids present in given samples of water (One ground water and one surface / tap water)

Competencies and Key competencies to be achieved by the student

Name of the Experiment (No of Periods)	Competencies	Key competencies
Familiarization of methods for Volumetric analysis (03)	--	--
Preparation of Std $Na_2 CO_3$ and making solutions of different dilution (03)	- Weighing the salt to the accuracy of .01 mg - Measuring the water with volumetric flask, measuring jar, volumetric pipette and graduated pipette - Making appropriate dilutions	- Weighing the salt to the accuracy of .01 mg - Measuring the water with volumetric flask, measuring jar, volumetric pipette and graduated pipette - Making appropriate dilutions
Name of the Experiment (No of Periods)	**Competencies**	**Key competencies**
Estimation of HCl solution using Std. $Na_2 CO_3$ solution (03)	- Cleaning the glassware and rinsing with appropriate solutions - Making standard solutions - Measuring accurately the standard solutions and titrants - Filling the burette with titrant - Fixing the burette to the stand	- Making standard solutions - Measuring accurately the standard solutions and titrants - Effectively Controlling the flow of the titrant - Identifying the end point - Making accurate observations
Estimation of NaOH using Std. HCl solution (03)		
Estimation of H_2SO_4 using Std. NaOH solution (03)		

Estimation of Mohr's Salt using Std. KMnO$_4$ (03)	• Effectively Controlling the flow of the titrant
Determination of acidity of water sample (03)	• Identifying the end point
Determination of alkalinity of water sample (03)	• Making accurate observations
Determination of total hardness of water using Std. EDTA solution (03)	• Calculating the results
Estimation of Chlorides present in water sample (03)	
Estimation of Dissolved Oxygen (D.O) in water sample (By titration method) (03)	

Estimation of Dissolved Oxygen (D.O) in water sample (By electrometric method) (03)	• Familiarize with instrument • Choose appropriate 'Mode' / 'Unit' • Prepare standard solutions / buffers, etc. • Standardize the instrument with appropriate standard solutions • Plot the standard curve • Make measurements accurately • Follow Safety precautions	• Prepare standard solutions / buffers, etc. • Standardize the instrument with appropriate standard solutions • Plot the standard curve • Make measurements accurately
Determination of pH using pH meter (03)		
Determination of conductivity of water and adjusting ionic strength to required level (03)		
Determination of turbidity of water (03)		

Name of the Experiment (No of Periods)	Competencies	Key competencies
Estimation of total solids present in water sample (03)	• Measuring the accurate volume and weight of sample • Filtering and air drying without losing any filtrate • Accurately weighing the filter paper, crucible and filtrate • Drying the crucible in an oven	• Measuring the accurate volume and weight of sample • Filtering and air drying without losing any filtrate • Accurately weighing the filter paper, crucible and filtrate

(Common to all Branches)

Computer Fundamentals Laboratory

Subject Title   : **Computer Fundamentals Laboratory**

Subject Code   : **M-111**
Periods/Week   : **03**
Periods/Year   : **90**

Time Schedule

S. No.	Major Topics	No. of sessions each of 3 periods duration	No. of Periods
I.	Computer hardware Basics	02	06
II.	Windows Operating System	02	06
III.	MS Word	08	24
IV.	MS Excel	09	27
V.	MS PowerPoint	09	27
	Total	30	90

Rationale: The knowledge of Computer usage has become a must for everyone, due to wide spread computer usage and related applications in all fields. This laboratory is designed to give the students hands on practice of Windows Operating System and MS Office to enable the students to use these skills in future courses.

I. Computer Hardware Basics (Not for end examination)
1. a) To familiarize with a Computer System and its hardware connections.
   b) To start and Shutdown a Computer correctly.
   c) To check the software details of the computer
   d) To practice Internal and External DOS commands
2. To check the hardware present in your computer.

II. Windows's operating system (Not for end examination)
3. To explore Windows Desktop
4. Working with Files and Folders
5. Windows Accessories: Calculator – Notepad – WordPad – MS Paint

III. Practice with MS-WORD
6. To familiarize with Ribbon layout of MS Word
        Home - Insert - Page layout – References – Review - View
7. To practice Word Processing Basics
8. To practice Formatting techniques

9. To insert a table of required number of rows and columns
10. To insert Objects, Clipart and Hyperlinks
11. To use Mail Merge feature of MS Word
12. To use Equations and symbols features

IV. Practice with MS-EXCEL

13. To familiarize with MS-EXCEL layout
14. To access and Enter data in the cells
15. To edit a spread sheet- Copy, Cut, Paste, and selecting Cells
16. To use built in functions and Formatting Data
17. To create Excel Functions, Filling Cells
18. To enter a Formula for automatic calculations
19. To practice Excel Graphs and Charts
20. To format a Worksheet in Excel, Page Setup and Print

V. Practice with MS-POWERPOINT

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

Competencies and Key Competencies to be achieved by the students

Exp No.	Name of the Experiment	Competencies	Key Competencies
1 (a).	To familiarize with Computer system and hardware connections	a. Identify the Parts of a Computer system a). CPU b) Monitor c) CD/DVD Drive d) Power Switch e) Start Button f) Reset Button b. Identify and connect various peripherals c. Identify and connect the cables used with computer system d. Identify various ports on CPU and connect Keyboard & Mouse	Connect cables to external hardware and operate the computer
1 (b).	To Start and Shut down Computer correctly	a. Log in using the password b. Start and shut down the computer c. Use Mouse and Keyboard	a. Login and logout as per the standard procedure b. Operate mouse & Keyboard
1 (c).	To explore Windows Desktop	a. Familiarize with Start Menu, Taskbar, Icons and Shortcuts b. Access application programs using Start menu, Task manager c. Use Help support	a. Access application programs using Start menu b. Use taskbar and Task manager

1(d).	To practice Internal and External DOS commands	a. Practice Internal commands b. Practice External commands	Familiarize with MS-DOS Commands
2.	To check the software details of the computer	c. Find the details of Operating System being used d. Find the details of Service Pack installed	Access the properties of computer and find the details
3.	To check the hardware present in your computer	a. Find the CPU name and clock speed b. Find the details of RAM and Hard disk present c. Access Device manager using Control Panel and check the status of devices like mouse and key board d. Use My Computer to check the details of Hard Disk Drives and partitions e. Use the Taskbar	a. Access device manager and find the details b. Type /Navigate the correct path and Select icon related to the details required
4.	Working with Files and Folders	a. Create folders and organizing files in different folders b. Use copy / paste or move commands to organize files and folders	a. Create files and folders rename , arrange and search for the required folder/file

Exp No.	Name of the Experiment	Competencies	Key Competencies
	Working with Files and Folders Continued....	c. Arrange icons – name wise, size, type, Modified d. Search a file or folder and find its path e. Create shortcut for files and folders (in other folders) on Desktop f. Familiarize with the use of My Documents g. Familiarize with the use of Recycle Bin	b. Restore deleted files from Recycle bin
5.	To use Windows Accessories: Calculator – Notepad – WordPad – MS Paint	a. Familiarize with the use of Calculator b. Access Calculator using Run command c. Create Text Files using Notepad and WordPad and observe the difference in file size d. Use MS paint and create .jpeg, .bmp files using MS Paint	a. Use windows accessories and select correct text editor based on the situation. b. Use MS Paint to create /Edit pictures and save in the required format.

6.	To familiarize with Ribbon layout of MS Word. – Home – Insert-Page Layout- References-Review-View	a. Create/Open a document b. Use Save and Save as features c. Work on two documents simultaneously d. Choose correct Paper size and Printing options	a. Create a Document and name appropriately and save b. Set paper size and print options
7.	To practice Word Processing Basics	a. Typing text b. Keyboard usage c. Use mouse (Left click / Right click / Scroll) d. Use Keyboard shortcuts e. Use Find and Replace features in MS- word f. Use Undo and Redo Features g. Use spell check to correct Spellings and Grammar	a. Use keyboard and mouse to enter/edit text in the document. b. Use shortcuts c. Use spell check/ Grammar features for auto corrections.
8.	To practice Formatting techniques	a. Formatting Text b. Formatting Paragraphs c. Setting Tabs d. Formatting Pages e. The Styles of Word f. Insert bullets and numbers g. Themes and Templates h. Insert page numbers, header and footer	a. Format Text and paragraphs and use various text styles. b. Use bullets and numbers to create lists c. Use Templates /Themes d. Insert page numbers date, headers and footers

Exp No.	Name of the Experiment	Competencies	Key Competencies
9.	To insert a table of required number of rows and columns	a. Edit the table by adding the fields – Deleting rows and columns –inserting sub table – marking borders. Merging and splitting of cells in a Table b. Changing the background colour of the table c. Use table design tools d. Use auto fit – fixed row/ column height/length – Even distribution of rows / columns features e. Convert Text to table and Table to Text f. Use Sort feature of the Table to arrange data in ascending/descending order	a. Insert table in the word document and edit b. Use sort option for arranging data.
10.	To Insert objects, clipart and Hyperlinks	a. Create a 2-page document. &Insert hyperlinks and Bookmarks. b. Create an organization chart c. Practice examples like preparing an Examination schedule notice with a hyperlink to Exam schedule table.	a. Insert hyperlinks &Bookmarks b. Create organization charts/flow charts
11.	To Use Mail merge feature of MS Word	a. Use mail merge to prepare individually addressed letters b. Use mail merge to print envelopes.	Use Mail merge feature
12.	To use Equations and symbols features.	a. Explore various symbols available in MS Word b. Insert a symbol in the text c. Insert mathematical equations in the document	Enter Mathematical symbols and Equations in the word document
13.	To Practice with MS-EXCEL	a. Open /create an MS Excel spreadsheet and familiarize with MS Excel 2007 layout like MS office Button- b. Use Quick Access Toolbar- Title Bar- Ribbon-Worksheets-Formula Bar-Status Bar	a. Familiarize with excel layout and use b. Use various features available in toolbar
14.	To access and Enter data in the cells	a. Move around a Worksheet-Quick access -Select Cells b. Enter Data-Edit a Cell-Wrap Text-Delete a Cell Entry-Save a File-Close Excel	a. Access and select the required cells by various addressing methods b. Enter data and edit

Exp No.	Name of the Experiment	Competencies	Key Competencies
15.	To edit spread sheet Copy, Cut, Paste, and selecting cells	a. Insert and Delete Columns and Rows-Create Borders-Merge and Center b. Add Background Color-Change the Font, Font Size, and Font Color c. Format text with Bold, Italicize, and Underline-Work with Long Text-Change a Column's Width	Format the excel sheet
16.	To use built in functions and Formatting Data	a. Sort and filter data in a worksheet b. Perform Mathematical Calculations verify -AutoSum c. Perform Automatic Calculations-Align Cell Entries	Use built in functions in Excel
17.	To enter a Formula for automatic calculations	a. Enter formula b. Use Cell References in Formulae c. Use Automatic updating function of Excel Formulae d. Use Mathematical Operators in Formulae e. Use Excel Error Message and Help	Enter formula for automatic calculations
18.	To Create Excel Functions, Filling Cells	a. Use Reference Operators b. Work with sum, Sum if , Count and Count If Functions c. Fill Cells Automatically	a. Create Excel sheets involving cross references and equations b. Use the advanced functions for conditional calculations
19.	To Practice Excel Graphs and Charts	a. Produce an Excel Pie Chart b. Produce an Excel Column Chart c. Practice creating any Chart	a. Use data in Excel sheet to Create technical charts and graphs Produce Excel Line Graph b. Produce a Pictograph in Excel
20.	To format a Worksheet in Excel, page setup and print	a. Shade alternate rows of data b. Add currency and percent symbols c. Change height of a row and width of a column d. Change data alignment e. Insert Headers and Footers f. Set Print Options and Print	a. Format Excel sheet b. Insert headers &footers and print
21.	To familiarize with Ribbon layout &features of PowerPoint 2007.	Use various options in Home, insert, design, animation , slideshow, Review &View in the PowerPoint	Access required options in the tool bar

Exp No.	Name of the Experiment	Competencies	Key Competencies
22.	To create a simple PowerPoint Presentation	a. Insert a New Slide into PowerPoint b. Change the Title of a PowerPoint Slide c. PowerPoint Bullets d. Add an Image to a PowerPoint Slide e. Add a Textbox to a PowerPoint slide	a. Create simple PowerPoint presentation with photographs/ClipArt and text boxes b. Use bullets option
23.	To Set up a Master Slide in PowerPoint and add notes	a. Create a PowerPoint Design Template b. Modify themes c. Switch between Slide master view and Normal view d. Format a Design Template Master Slide e. Add a Title Slide to a Design Template f. The Slide Show Footer in PowerPoint f. Add Notes to a PowerPoint Presentation	a. Setup Masterslide and format b. Add notes
24.	To Insert Text and Objects	a. Insert Text and objects b. Set Indents and line spacing c. Insert pictures/ clipart d. Format pictures e. Insert shapes and WordArt f. Use 3d features g. Arrange objects	Inset Text and Objects Use 3d features
25.	To insert a Flow Chart / Organizational Charts	a. Create a Flow Chart in PowerPoint b. Group and Ungroup Shapes c. Use smart art	Create organizational charts and flow charts using smart art
26.	To insert a Table	a. PowerPoint Tables b. Format the Table Data c. Change Table Background d. Format Series Legend	Insert tables and format
27.	To insert a Charts/Graphs	a. Create 3D Bar Graphs in PowerPoint b. Work with the PowerPoint Datasheet c. Format a PowerPoint Chart Axis d. Format the Bars of a Chart e. Create PowerPoint Pie Charts f. Use Pie Chart Segments g. Create 2D Bar Charts in PowerPoint h. Format the 2D Chart e. Format a Chart Background	Create charts and Bar graphs, Pie Charts and format.

Exp No.	Name of the Experiment	Competencies	Key Competencies
28.	To Insert audio &video, Hyperlinks in a slide Add narration to the slide	a. Insert sounds in the slide and hide the audio symbol b. Adjust the volume in the settings c. Insert video file in the format supported by PowerPoint in a slide d. Use automatic and on click options e. Add narration to the slide f. Insert Hyperlinks	a. Insert Sounds and Video in appropriate format. b. Add narration to the slide c. Use hyperlinks to switch to different slides and files
29.	To Practice Animation effects	a. Apply transitions to slides b. To explore and practice special animation effects like *Entrance, Emphasis, Motion Paths &Exit*	Add animation effects
30.	Reviewing presentation	a. Checking spelling and grammar b. Previewing presentation c. Set up slide show d. Set up resolution e. Exercise with Rehearse Timings feature in PowerPoint f. Use PowerPoint Pen Tool during slide show g. Saving h. Printing presentation (a) Slides (b) Handout	a. Use Spell check and Grammar feature b. Setup slide show c. Add timing to the slides d. Setup automatic slide show

III SEMESTER

DIPLOMA IN MECHANICAL ENGINEERING
SCHEME OF INSTRUCTION AND EXAMINATION
CURRICULUM-16
III Semester

Sub code	C16-Subjects	No of Periods per week		Total periods per semester	Scheme of Examination			
		Theory	Practice		Duration (Hrs)	Sessional Marks	End Exam Marks	Total Marks
THEORY								
M-301	Engineering Mathematics-II	5		75	3	20	80	100
M-302	Strength of Materials	6		90	3	20	80	100
M-303	Thermal Engineering-I	6		90	3	20	80	100
M-304	Production Technology-I	5		75	3	20	80	100
M-305	Basic Electrical Engineering & Electronics	5		75	3	20	80	100
PRACTICAL								
M-306	Machine Drawing		6	90	3	40	60	100
M-307	Fuels lab and Electrical Engineering Lab		3	45	3	20+20	30+30	100
M-308	Materials testing lab		3	45	3	40	60	100
M-309	Workshop Practice-II		3	45	3	40	60	100
	T O T A L	**27**	**15**	**630**		**260**	**640**	**900**

Engineering Mathematics-II

Subject Title   :   **Engineering Mathematics-II**
Subject Code   :   **A-301**
 Periods per week   :   **05**
 Periods per Semester :   **75**

Blue print

Upon completion of the subject the student shall be able to

S. No	Major Topic	No of Periods	Weightage of Marks	Short Type			Essay Type		
				R	U	App	R	U	App
	Unit - I								
1	**Indefinite Integration**	15	21	1	1	0	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$
	Unit - II								
2	**Definite Integration and its applications**	35	60	1	1	3	1	1	$2\frac{1}{2}$
	Unit - III								
3	**Differential Equations**	25	29	2	1	0	1	1	0
	Total	**75**	**110**	**4**	**3**	**3**	**2$\frac{1}{2}$**	**2$\frac{1}{2}$**	**3**
			Marks:	12	9	9	25	25	30

R: **Remembering type**   37 marks
U: **Understanding type**   34 marks
App: **Application type**   39 marks

OBJECTIVES

Unit-I
1.0   Indefinite Integration
   1.1   Explain the concept of Indefinite integral as an anti-derivative.
   1.2   State the indefinite integral of standard functions and properties of Integrals $\int (u + v)\ dx$ and
          $\int ku\ dx$ where k is constant and *u, v* are functions of *x.*
   1.3   Solve integration problems involving standard functions using the above rules.
   1.4   Evaluate integrals involving simple functions of the following type by the method of
          substitution.
             i*)* $\int f(ax + b)\ dx\ where$ $f(x)\ dx$ is in standard form*.*
             ii) $\int [f(x)]^{n}\ f\ '(x)\ dx$
             iii) $\int f\ '(x)/[f(x)]\ dx$
             iv) $\int f\ \{g(x)\}\ g\ '(x)\ dx$

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

1.6   Evaluate the integrals of the form $\int Sin^m\theta \ Cos^n \theta. \ d\theta$ where m and n are positive integers.

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

1.8   Evaluate the Standard Integrals of the functions of the type

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

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

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

1.9   Evaluate the integrals of the type

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

1.10   Evaluate integrals using decomposition method.

1.11   Evaluate integrals using integration by parts with examples.

1.12   State the Bernoulli's rule for evaluating the integrals of the form $\int u \, .vdx$.

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

Unit-II

(a)   Understand definite integral and its properties

2.1   State the fundamental theorem of integral calculus

2.2   Explain the concept of definite integral.

2.3   Calculate the definite integral over an interval.

2.4   State various properties of definite integrals.

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

(b)   Real life applications of definite integrals

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

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

2.8   Obtain the volumes of solids of revolution.

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

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

(c) Certain special integrals: Laplace Transforms

2.11   Write the definition of Laplace Transform and explain sufficient conditions for its existence.

2.12   Provide formulae for Laplace transforms of standard functions.

2.13   State Linear property, First shifting property, Change of Scale property for Laplace transforms. Solve simple problems using these properties.

2.14   Write formulae for Laplace transform of $t^n f(t), \ \dfrac{f(t)}{t}, \ f^{(n)}(t), \ \int\limits_{0}^{t} f(u) \, du$ in terms of Laplace transform of $f(t)$. Provide simple examples on these functions.

2.15   Define unit step function and write the Laplace Transform of unit step function.

State second shifting property.

2.16 Define inverse Laplace Transform and write inverse Laplace Transform of standard functions. Solve simple problems.

2.17 Write first shifting property of inverse Laplace Transform with examples

2.18 Define convolution of two functions and state convolution theorem with few examples for understanding only.

(d)   Understand the Fourier series expansion of functions

2.19 Define Fourier series of a function on the interval $(c, c + 2l)$ and state sufficient conditions for its existence. Write the Euler's formulae for determining the Fourier coefficients.

2.20 Find Fourier series of simple functions in the range $(0,2l), (0,2\pi), (-l, l)$ and $(-\pi, \pi)$.

2.21 Find Fourier coefficients for even and odd functions in the interval $(-l, l)$ and $(-\pi, \pi)$ in simple examples.

2.22 Define half range Fourier sine and cosine series of a function over the interval $(0, l)$ with examples.

3.0   Introduction to Differential Equations

3.1 Define a Differential equation, its order, degree

3.2 Form a differential equation by eliminating arbitrary constants.

3.3 Solve the first order first degree differential equations by the following methods:

    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.

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

3.4 Solve Differential equations of the type $(aD^2 + bD + c)y = 0$ when the roots of the auxiliary equation are real and different, real and repeated, Complex conjugates.

3.5 Solve the higher order homogeneous differential equations with constant coefficients.

3.6 Explain the concept of complementary function, particular Integral and general solution of a differential equation.

3.7 Solve n^{th} 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} , Sinax, Cosax, x^n.

3.8 Solve simple problems leading to engineering applications

COURSE CONTENT

Unit-I

Indefinite Integration:

1**.** Integration regarded as anti-derivative – Indefinite integral of standard functions.   Properties of indefinite integral. 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, cosec x and powers of tan x, sec x by substitution.

Evaluation of integrals which are reducible to the following forms :

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

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

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

Integration by decomposition of the integrand into simple rational, algebraic functions. Integration by parts, Bernoulli's rule.

Unit-II
Definite Integral and its applications:
2. Definite integral-fundamental theorem of integral calculus, properties of definite integrals, evaluation of simple definite integrals. Definite integral as the limit of a sum. Area under plane curves – Area enclosed between two curves. Volumes of solids of revolution. Mean and RMS values of a function on a given interval. Trapezoidal rule, Simpson's 1/3 rule to evaluate an approximate value of a define integral.

. Definition, sufficient conditions for existence of Laplace Transform (LT), LT of elementary functions, linearity property, scale change property, first shifting property, multiplication by t^n, division by t, LT of derivatives and integrals, unit step function, LT of unit step function, second shifting theorem, inverse Laplace transforms- shifting theorems and change of scale property, multiplication by s^n and division by s – examples of inverse LT using partial fractions – convolution theorem (no proof).
Representation of a function in Fourier series over the interval $(c, c+2l)$, Give sufficient conditions for existence of Fourier series. Euler's formulae for Fourier coefficients, Finding Fourier coefficients for simple functions, elementary even and odd functions. Define half range Fourier series.

Unit -III
Differential Equations:
Definition of a differential equation-order and degree of a differential equation- formation of differential equations-solution of differential equation of first order, first degree: variable-separable, homogeneous, exact, linear differential equation, Bernoulli's equation.

Homogenous linear differential equations with constant coefficients of order two and higher with emphasis on second order.
Non-homogenous linear differential equations with constant coefficients of the form
$f(D)y = X$, where X is in the form k, e^{ax}, sin ax, cos ax, x^n, (n= 1,2) – complimentary function, particular integral and general solution.

Reference Books:
1. Integral Calculus Vol.I, by M.Pillai and Shanti Narayan
2. Thomas' Calculus, Pearson Addison –Wesley Publishers
3. A Text book of Engg. Mathematics by B.S.Grawel
4. A Text book of Engg. Mathematics by B.V.Ramana- T.Mc Graw Hill Publishers

STRENGTH OF MATERIALS

Subject Title : **Strength of Materials**
Subject Code : **M-302**
Periods/Week : **06**
Periods per Semester : **90**

TIME SCHEDULE

S No.	Major Topics	No. of Periods	Weightage of Marks	Short answer Questions	Essay type Questions	Unit Test bifur-cation
1	Simple Stresses and Strains	15	16	2	1	Unit Test - I
2	Strain energy	08	13	1	1	
3	Thin Cylindrical shells	08	13	1	1	
4	Shear Force and Bending moment Diagrams	15	13	1	1	
5	Theory of Simple bending	12	13	1	1	Unit Test - II
6	Deflection of Beams	07	13	1	1	
7	Torsion in Shafts	15	16	2	1	
8	Springs	10	13	1	1	
	Total	**90**	**110**	**10**	**8**	

OBJECTIVES

Up on completion of the course the student shall be able to

1 Simple Stresses and Strains
1.1. Define the strength, Mechanical properties of commonly used engineering materials.
1.2 Identify the nature and effect of tensile, compressive and shear forces.
1.3 Define the terms stress, strain
1.4 State Hook's law, define the terms Poisson's ratio and elastic modulii
1.5 Draw the typical stress - strain curve for ductile and brittle materials under tension indicating salient points on it.
1.6 Mention the significance of Factor of Safety.
1.7 Write down the relation between elastic constants E,N,K,& 1/m.
1.8 Compute stress and strain values in bodies of uniform section and of composite section under the influence of normal forces.
1.9 Calculate thermal stresses, in bodies of uniform section and composite sections.
1.10 Compute changes in axial, lateral and volumetric dimensions of bodies of uniform sections under the action of normal forces.

2 Strain Energy
2.1 Define resilience, 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) Gradually applied load.
　　ii) Suddenly applied load
　　iii) Impact/shock load.
2.4 Comparison of proof resilience in bodies subjected to the above loads.

3 Thin Cylindrical Shells
3.1 Definition of cylindrical shell

3.2 Definition of longitudinal and hoop stress

3.3 Derive the expression for longitudinal, hoop and shear stress for seamless and seam shells.

3.4 Longitudinal, hoop and volumetric strain and change in dimensions of a seamless shell subjected to internal fluid pressure

3.5 Design of thin cylindrical shells.

4 Shear Force and Bending Moment Diagrams
4.1 List the types of beams.
4.2 List the types of loading
4.3 Explain the terms shear force and bending moment.
4.4 Compute shear force and bending moment at any section of beam.
4.5 Draw the diagrams of S.F. & B.M for cantilever, simple supported and overhanging beams (for overhanging beams combination of point loads and udl not included)

5 Theory of Simple Bending
5.1 State the theory and terms of simple bending.
5.2 List the assumptions in theory of simple bending
5.3 Derive the bending equation $M / I = \sigma / y = E / R$
5.4 Calculate Bending stress, Modulus of section and Moment of resistance.
5.5 Calculate the safe load, safe span and dimensions of cross section.

6 Deflection of Beams
6.1 Define and explain the term deflection.
6.2 State the formulae for deflection in cantilever and simply supported beams under standard conditions
6.3 Calculate the values of deflection in the given beams.

7 Torsion in Shafts
7.1 Function of Shaft
7.2 Explain Polar M.I. of solid and hollow shaft
7.3 List the assumptions in theory of Simple Torsion
7.4 Derive the torque equation $T / J = f_s / R = G\theta / L$
7.5 Design of solid and hollow shafts and power transmitted
7.6 Comparison for strength and weight of solid and hollow shafts of the same length and material

8 Springs
8.1 Function of spring
8.2 Types and applications of springs
8.3 Define the terms related to closed coil helical spring
8.4 State the formulae for the stress and deflection of closed coil helical spring
8.5 Compute the stress and deflection of the closed coil helical spring
8.6 Define the terms related to semi-elliptic or leaf spring or laminated spring
8.7 State the formulae for the stress and deflection of leaf spring
8.8 Compute the stress and deflection of leaf spring

COURSE CONTENT

1 Simple Stresses and Strains
1.1 Types of forces.
1.2 Stress, Strain and their nature.
1.3 State Hook's law; know about Poisson's ratio, elastic modulii
1.4 Mechanical properties of common engineering materials.
1.5 Significance of various points on stress – strain diagram for M.S. and C.I. specimens
1.6 Significance of factor of safety

1.7   Relation between elastic constants.
1.8   Stress and strain values in bodies of uniform section and of composite section under the influence of normal forces.
1.9   Thermal stresses in bodies of uniform section and composite sections.
1.10   Related numerical problems on the above topics

2   Strain Energy
2.1   Strain energy or resilience, proof resilience and modulus of resilience.
2.2   Derivation of strain energy for the following cases
       i)   Gradually applied load.
       ii)   Suddenly applied load
       iii)   Impact/shock load.
2.3   Related numerical problems.

3   Thin Cylindrical Shells
3.1   Explanation of longitudinal and hoop stresses in the light of
       Circumferential and longitudinal failure of shell.
3.2   Derivation of expressions for the longitudinal and hoop stress for seamless and seam shells.
3.3   State the expressions for change in dimensions and respective strains
3.4   Related numerical problems for safe thickness, safe working pressure, stresses, strains and change in dimensions of thin cylindrical shells

4   Shear Force & Bending Moment Diagrams
4.1   Types of beams with examples.
       a)   Cantilever beam,
       b)   Simply supported beam,
       c)   Over hanging beam,
       d)   Continuous beam,
       e)   Fixed beam.
4.2   Types of Loads – Point load, UDL and UVL.
4.3   Definition and explanation of shear force and bending moment.
4.4   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 point loads.
       d)   Simply supported beam with uniformly distributed load.
       e)   Combination of point and U.D.L. for the above and problems there upon.
       f)   Over –hanging beam with point loads, at the centre and at free ends.
       g)   Over – hanging beam with uniformly distributed load throughout.

5   Theory of Simple Bending Deflection of Beams
5.1   Explanation of terms
       a)   Neutral layer
       b)   Neutral Axis
       c)   Modulus of Section
       d)   Moment of Resistance
       e)   Bending stress.
       f)   Radius of curvature.
5.2   Assumptions in theory of simple bending.
5.3   Bending Equation $M / I = \sigma / Y = E / R$ with derivation.
5.4   Problems involving calculations of bending stress, modulus of section and moment of resistance.
5.5   Calculation of safe loads and safe span and dimensions of cross- section.

6   **Deflection of Beams**
    6.1   Definition and explanation of deflection as applied to beams.
    6.2   Deflection formulae without proof for cantilever and simply   supported beams with point   load   and   uniformly   distributed   load   only   (Standard cases only).
    6.3   Related numerical problems.

7   **Torsion in Shafts**
    7.1   Definition and function of shaft
    7.2   Calculation of polar M.I. for solid and hollow shaft.
    7.3   Assumptions in simple torsion
    7.4   Derivation of formula $T / J = fs / R = G\theta / L$
    7.5   Problems on design of shaft based on strength and rigidity
    7.6   Numerical Problems related to comparison of strength and weight of solid and hollow shafts

8   **Springs**
    8.1   Explanation about spring
    8.2   Classification of springs
    8.3   Nomenclature of closed coil helical spring
    8.4   Deflection formula for closed coil helical spring (without derivation)
    8.5   Explanation about stiffness of spring
    8.6   Semi elliptical leaf spring deflection and stress formula (without derivation)
    8.7   Numerical problems on closed coil helical spring and leaf spring to find safe load, deflection, size of coil and number of coils/plates.

REFERENCE BOOKS:

1.   Strength of Materials by Sadhu Singh, Khanna Publishers
2.   Strength of Materials by R.S. Khurmi   , S Chand & Company
3.   Strength of Materials by Ramamrutham, Dhanpatrai Publications

Subject Title	:	Thermal Engineering-I	
Subject Code	:	M-303	
Periods/Week	:	06	
Periods per Semester	:	90	

TIME SCHEDULE

S. No.	Major Topics	Periods	Weightage of Marks	SAQ	EAQ	Unit Test bifur-cation
1	Perfect gas laws	08	13	1	1	Unit Test – I
2	Fundamentals of Thermodynamics	08	13	1	1	Unit Test – I
3	Laws of Thermodynamics	12	13	1	1	Unit Test – I
4	Thermodynamic Processes on gases	16	16	2	1	Unit Test – I
5	Air standard cycles	10	13	1	1	Unit Test - II
6	Internal combustion engines	16	16	2	1	Unit Test - II
7	Performance of IC engines	10	13	1	1	Unit Test - II
8	Air Compressors	10	13	1	1	Unit Test - II
	T O T A L	**90**	**110**	**10**	**8**	

OBJECTIVES

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

1. Perfect gas laws
1.1. State Boyle's law, Charles law, Avogadro's law, Joule's law and express them mathematically
1.2. Write characteristic gas equation and universal gas equation, and state the SI units of the terms used
1.3. State the relation between characteristic and universal gas constants
1.4. Define specific heats at constant volume and at constant pressure for a perfect gas
1.5. State Regnault's law, and express it mathematically
1.6. State the relationship between the two specific heats of a gas and its characteristic gas constant with proper units
1.7. Solve simple problems applying gas laws and gas equations

2. Fundamentals of Thermodynamics
2.1. Define system, surroundings, universe, working fluid
2.2. Define the types of systems with practical examples
2.3. Define intrinsic and extrinsic properties of a system with practical examples
2.4. Define pressure, volume, temperature, density, enthalpy and internal energy of a system stating their SI units
2.5. Explain with illustration quasi-static work and flow work
2.6. Define thermodynamic State, Path, Process and Cycle with graphical representations

2.7.   Differentiate between a reversible and irreversible processes
2.8.   State the conditions for reversibility of a process and a cycle

3. Laws of Thermodynamics
3.1.   State zeroth law of thermodynamics
3.2.   State the significance of zeroth law
3.3.   Differentiate between heat, temperature and thermal equilibrium
3.4.   Differentiate between heat and work forms of energy
3.5.   State first law of thermodynamics for a process and for cycle
3.6.   State the significance of first law
3.7.   Define Joule's constant
3.8.   Apply first law to solve simple problems on heat and work conversions in thermodynamic processes and cycles
3.9.   Write non flow energy equation (NFEE) and state the units of the terms involved
3.10.   Apply NFEE to solve simple problems on closed systems
3.11.   Write steady flow energy equation (SFEE) and state the units of the terms involved
3.12.   Apply SFEE to solve simple problems on open systems
3.13.   State the limitations of first law of thermodynamics
3.14.   State the Clausius and Kelvin-Planck statements of second law of thermodynamics
3.15.   State the significance of second law
3.16.   Illustrate heat engine, refrigerator and heat pump
3.17.   Define thermal efficiency of a heat engine
3.18.   Solve simple problems on the concept of heat engine and heat pump
3.19.   Define availability and unavailability
3.20.   Define change in entropy of a system, and explain its significance
3.21.   Write the expression for change in entropy of a system and state its SI units

4. Thermodynamic processes on gases
4.1.   List out the popular thermodynamic processes on gases
4.2.   Write the expressions for mathematical representation, change in enthalpy, change in internal energy, work transfer, heat transfer, and change in entropy for Isochoric process
4.3.   Solve simple problems on Isochoric process
4.4.   Write the expressions for mathematical representation, change in enthalpy, change in internal energy, work transfer, heat transfer, and change in entropy for Isobaric process
4.5.   Solve simple problems on Isobaric process
4.6.   Write the expressions for mathematical representation, change in enthalpy, change in internal energy, work transfer, heat transfer, and change in entropy for Hyperbolic process
4.7.   Define Isothermal process
4.8.   Show that for a perfect gas, Hyperbolic process is nothing but Isothermal process
4.9.   Solve simple problems on Hyperbolic/Isothermal process
4.10.   Write the expressions for mathematical representation, change in enthalpy, change in internal energy, work transfer, heat transfer, and change in entropy for adiabatic process
4.11.   Differentiate between adiabatic and isentropic processes
4.12.   Explain that a frictionless adiabatic process is nothing but an isentropic process
4.13.   Solve simple problems on frictionless adiabatic/isentropic process
4.14.   Write the expressions for mathematical representation, change in enthalpy, change in internal energy, work transfer, heat transfer, and change in entropy for Polytropic process
4.15.   Solve simple problems on Polytropic process
4.16.   Differentiate between isenthalpic and throttling processes
4.17.   Show that for a perfect gas isenthalpic and throttling processes are the same
4.18.   Show that Polytropic process is a general representation of all thermodynamic processes
4.19.   Represent all the above processes on p-V and T-s graphs

5. Air standard cycles

5.1. Define air standard cycle
5.2. List out successful air standard cycles and their practical applications
5.3. Represent Carnot cycle on p-V and T-s diagrams
5.4. State the assumptions made in the development of Carnot cycle
5.5. Write the expression for thermal efficiency of a Carnot cycle
5.6. Solve simple problems on analysis of Carnot cycle
5.7. Explain why Carnot cycle is practically impossible
5.8. Represent Otto cycle on p-V and T-s diagrams
5.9. State the assumptions made in the development of Otto cycle
5.10. Write the expression for thermal efficiency of an Otto cycle
5.11. Solve simple problems on analysis of Otto cycle
5.12. Represent Diesel cycle on p-V and T-s diagrams
5.13. State the assumptions made in the development of Diesel cycle
5.14. Write the expression for thermal efficiency of a Diesel cycle
5.15. Solve simple problems on analysis of Diesel cycle
5.16. Explain why Carnot cycle is the most efficient of all cycles working between the same temperature limits

6. Internal Combustion Engines

6.1. Classify Heat engines with practical examples
6.2. Differentiate between external and internal combustion engines
6.3. Differentiate between rotary and reciprocating engines
6.4. Illustrate the principal parts of IC engines
6.5. State the materials used for the principal parts
6.6. Define calorific value of a fuel
6.7. Differentiate between the HCV and LCV of a fuel
6.8. Name the commercially available fuels for IC engines along with their HCV
6.9. Illustrate the working of a four stroke diesel engine
6.10. Illustrate the working of a four stroke petrol engine
6.11. Illustrate the working of a two stroke diesel engine
6.12. Illustrate the working of a two stroke petrol engine
6.13. Compare two stroke and four stroke engines
6.14. Compare diesel and petrol engines
6.15. Sketch the valve timing diagram for a four stroke diesel engine
6.16. Sketch the valve timing diagram for a two stroke petrol engine
6.17. Sketch the fuel circuit of a diesel engine
6.18. Illustrate the working of a fuel pump
6.19. Illustrate the working of a fuel injector
6.20. Sketch the fuel circuit of a petrol engine
6.21. Illustrate the working of a Zenith carburettor
6.22. State the necessity of engine cooling
6.23. Classify cooling systems
6.24. Illustrate air cooling system and state its practical applications
6.25. Illustrate water cooling system with a radiator and circulating pump and state its practical applications
6.26. Compare air and water cooling systems
6.27. State the functions of ignition system
6.28. Illustrate the working of a Coil ignition system, and state its practical applications
6.29. Illustrate the working of a Magneto ignition system, and state its practical applications
6.30. Compare Coil and Magneto ignition systems
6.31. State the necessity of lubrication in IC engines
6.32. Classify lubricating systems
6.33. Illustrate splash lubrication system and state its applications
6.34. Illustrate forced lubrication system and state its applications
6.35. State the necessity of engine governing

6.36. Differentiate between a flywheel and a governor
6.37. Explain quality governing system
6.38. Explain quantity governing system
6.39. State the advantages of multi cylinder engines

7. Performance of IC engines

7.1. Write the expressions for Indicated power, brake power, friction power, mechanical efficiency, air standard efficiency, indicated thermal efficiency, relative efficiency, brake thermal efficiency, specific fuel consumption with proper units
7.2. Know the values of mechanical efficiency, air standard efficiency, indicated thermal efficiency, relative efficiency, brake thermal efficiency, specific fuel consumption of a commercially available healthy IC engine
7.3. Solve simple problems on estimation of the above parameters for an engine, from performance test data
7.4. Illustrate the heat balance sheet for an IC engine
7.5. Know the heat balance sheet values of a commercially available healthy IC engine
7.6. Solve simple problems on heat balance sheet for an IC engine from performance test data
7.7. Explain the principle of Morse test, and state its limitations
7.8. Solve simple problems on Morse test from engine test data
7.9. Write the expression for minimum air required for complete combustion of a given fuel
7.10. Solve simple problems on estimating the minimum air required for complete combustion of a given fuel
7.11. Estimate the percentage of gaseous constituents in the flue gases obtained after complete combustion of a given fuel
7.12. Name the gaseous pollutants in the flue gases released from an IC engine
7.13. Know the commercially available equipment for pollution check on an IC engine

8. Air Compressors

8.1. Name the practical applications of compressed air
8.2. Classify compressors
8.3. Differentiate between single acting and double acting compressors
8.4. Compare Reciprocating and Rotary compressors
8.5. Illustrate the working of single stage, single acting, reciprocating air compressor
8.6. Draw the theoretical indicator diagram for the above compressor
8.7. Write the expressions for theoretical work and power required to drive the compressor
8.8. Solve simple problems on single stage, single acting reciprocating air compressor
8.9. State the advantage of multi stage compression
8.10. Draw the layout of two stage, single acting reciprocating air compressor
8.11. Draw the theoretical indicator diagram for the above compressor
8.12. State the conditions for minimum work on the above two stage compressor
8.13. Write the expression for theoretical minimum work for the above two stage compressor
8.14. Solve simple problems on two stage, single acting reciprocating air compressor
8.15. Illustrate the working of a centrifugal compressor
8.16. Illustrate the working of an axial flow compressor
8.17. Illustrate the working of a vane type rotary compressor
8.18. Define volumetric efficiency of an air compressor
8.19. Know the range of volumetric efficiency for a commercially available healthy compressor
8.20. Explain the calculation of volumetric efficiency of a reciprocating air compressor from test data
8.21. Solve simple problems on calculation of volumetric efficiency of a reciprocating air compressor

COURSE CONTENT

1. Perfect gas laws
1.1.   Perfect Gas Laws – Boyle's law, Charles's Law, Avogadro's law, Joule's law
1.2.   Characteristic and universal gas equations (derivations omitted) – relationship between universal and characteristic gas constants
1.3.   Specific heats of perfect gas at constant pressure and at constant volume -Regnault's law- relationship between the two specific heats and characteristic gas constant (derivation omitted)
1.4.   Simple problems on gas laws and gas equations

2. Fundamentals of Thermodynamics
2.1.   Definitions for system, boundary, surroundings, universe, working fluid
2.2.   Types of thermodynamic systems – closed, open and isolated systems with examples
2.3.   Properties of system- intrinsic and extrinsic properties with examples - definitions for properties like pressure, volume, temperature, enthalpy, internal energy, density, with their units - definitions for quasi-static work, flow work
2.4.   Definitions for thermodynamic State, Path, Process and Cycle – their graphical representation – concept of reversibility and conditions for reversibility of a process and cycle

3. Laws of Thermodynamics
3.1.   Zeroth law of thermodynamics – statement and explanation – its significance – difference between heat and temperature - concept of thermal equilibrium
3.2.   First law of thermodynamics – its significance – differences between heat and work forms of energy – Joule's constant – first law applied to a cycle – simple problems on heat and work conversions in process and cycle
3.3.   Non flow energy equation (NFEE) (without proof) – simple problems on the application of NFEE
3.4.   Steady flow energy equation (SFEE) (without proof) - simple problems on the application of SFEE
3.5.   Limitations of First law of thermodynamics –development of second law of thermodynamics – its significance - Clausius and Kelvin-Planck statements of second law - concept of heat engine, refrigerator and heat pump -thermal efficiency of a heat engine - simple problems on application of second law
3.6.   Definitions for availability and unavailability – concept of change in entropy – expression for change in entropy (without proof) – units of change in entropy – significance of change in entropy

4. Thermodynamic processes on gases
4.1.   Introduction to popular thermodynamic processes – their mathematical representation – expressions(without proof) for change in enthalpy, change in internal energy, work transfer, heat transfer, and change in entropy in these processes - representation of these processes on p -V and T-s diagrams - simple problems on the following processes:
4.2.   Isochoric process
4.3.   Isobaric process
4.4.   Hyperbolic process
4.5.   Isothermal process
4.6.   Isentropic process
4.7.   Polytropic process
4.8.   Isenthalpic process

5. Air standard cycles
5.1.   Meaning of air standard cycle –introduction to popular air standard cycles and their practical applications
5.2.   Carnot cycle – representation on p-V and T-s diagrams - assumptions made – expression (derivation omitted) for thermal efficiency – simple problems

5.3. Otto cycle – representation on p-V and T-s diagrams - assumptions made – expression (derivation omitted) for thermal efficiency – simple problems

5.4. Diesel cycle – representation on p-V and T-s diagrams - assumptions made – expression (derivation omitted) for thermal efficiency – simple problems

5.5. Reasons for the highest efficiency of Carnot cycle over other cycles working between same temperature limits.

6. Internal Combustion Engines

6.1. Heat engines – classification– comparison of EC and IC engines - classification of IC engines – layout of an IC engine –functions of principal parts - materials used for the parts - fuels used in IC engines – commercially available fuels – higher and lower calorific value of fuels

6.2. Layout of four stroke diesel/petrol engine– working cycle - layout of two stroke diesel/petrol engine – working cycle – comparison of four stroke and two stroke engines - comparison of diesel and petrol engines- valve timing diagrams for two stroke and four stroke diesel/petrol engines

6.3. Layout of fuel system for diesel engine – functions of principal components – working of fuel pump and injector (line sketches only)- layout of fuel system for petrol engines – functions of principal components - working of a Zenith Carburettor (line sketch only)

6.4. Cooling systems –layout of air cooling system–layout of water cooling system with radiator and forced circulation (line sketches only) - comparison of air cooling and water cooling systems

6.5. Ignition systems – layout of coil ignition system –layout of magneto ignition system - comparison of the two systems

6.6. Lubricating systems –layout of splash lubrication –practical applications – layout of forced lubrication system – practical applications

6.7. Governing systems – difference between governor and flywheel – quality and quantity methods of governing and their applications

6.8. Need of multicylinder engines – advantages over single cylinder engines

7. Performance of IC engines

7.1. Expressions (without proof) for Indicated power, brake power, friction power, mechanical efficiency, air standard efficiency, indicated thermal efficiency, relative efficiency, brake thermal efficiency, specific fuel consumption – typical values for a healthy engine - Simple problems on the calculation of the above

7.2. Heat balance sheet – typical layout for a healthy IC engine - simple problems on heat balance

7.3. Morse test – its applications – simple problems

7.4. Expressions (without proof) for minimum air required for complete combustion of a given fuel – simple problems - flue gas analysis for an IC engine given the composition of the fuel (minimum air case only) – simple problems

7.5. Gaseous pollutants in flue gases – need for pollution control – commercially available equipment for pollution check

8. Air Compressors

8.1. Uses of compressed air – types of air compressors – layout of single stage, single acting, reciprocating air compressor - construction and working – indicator diagram

8.2. Formulae for work done and power required- simple problems on calculation of work and power required

8.3. Advantage of multistage compression - layout of two stage, single acting reciprocating air compressor – indicator diagram - conditions for minimum work (without proof) - formulae for work done and power required – simple problems

8.4. Rotary compressors – types – descriptive treatment of centrifugal compressor, axial flow type compressor and vane type compressors

8.5. Volumetric efficiency of a compressor – typical value for a healthy compressor – simple problems on estimation of volumetric efficiency of a compressor

REFERENCE BOOKS

Sno	Title of the Book	Author	Publisher
1	Elements of Heat Engines, Vol-I, II, III	R.C. Patel and C.J. Karamchandani	Acharaya Publications
2i	Thermal Engineering	R.S.Khurmi	S.Chand

Subject title : **Production Technology-I**
Subject code : **M- 304**
Periods per week : **05**
Periods per semester :**75**

TIME SCHEDULE

SNo.	Major Topics	No. Of Periods	Weightage	SAQ	EAQ	Unit test Bifurcation
1	Lathe and Lathe work	16	16	02	01	Unit Test-I
2	Production Lathes	08	13	01	01	
3	Shaper, Slotter, Planner	12	16	02	01	
4	Broaching Machine	05	10	-	01	Unit Test-II
5	Cutting Fluids, Coolants and Lubricants	06	13	01	01	
6	Welding	16	26	02	02	
7	Metrology	12	16	02	01	
	Total	**75**	**110**	**10**	**08**	

OBJECTIVES

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

1.   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.   Illustrate the methods of taper turning .
1.9.   Calculate the included angle for taper turning.
1.10.   List out different work holding devices.
1.11.   Explain the Nomenclature of Lathe (single point) tool.
1.12.   State functions of various angles.
1.13.   Tool signature.

2.   Production Lathes
2.1.   Identify various types of Production lathes.
2.2.   Illustrate the working principle of turret lathe, Capstan, Automatic and Semi- automatic lathes & copying lathes.
2.3.   Know the differences between automatic and semi-automatic lathes.
2.4.   Know the need of copying lathes.
2.5.   State the advantages and applications of production lathes.

3.   **Illustrate the working of Shaper, Slotter, Planer.**
3.1.   State the working principles of these machines with line sketches.

3.2.   Illustrate the constructional details of the machines.
3.3.   Explain the functions of important parts of the machines.
3.4.   List out the operations performed on these machines.
3.5.   State the specifications of each machine
3.6.   Name the various work holding and tool holding devices used in the above machines
3.7.   Explain the principle of quick-return mechanism as applied to shaper/planer.
3.8.   Describe the different methods of obtaining quick return motion.
3.9.   Explain the principle of hydraulic drive with the help of a line diagram applied to shaper.

4. Broaching Machine
4.1.   Define Broaching.
4.2.   Illustrate the constructional details of the machines.
4.3.   Categorise the broaching machines.
4.4.   Illustrate the working of the broaching.
4.5.   State the advantages & limitations of broaching

5. Cutting Fluids, Coolants & Lubricants.
5.1.   State the properties of cutting fluids and coolants.
5.2.   Mention the types of fluids.
5.3.   State the composition of cutting fluids and coolants.
5.4.   List out the relative merits of the cutting fluids and coolants.
5.5.   Select the proper cutting fluids and coolants for various machining operations.
5.6.   Classify the Lubricants.
5.7.   Identify various properties of Lubricants.

6. Understand the different Welding Methods and Techniques.
6.1.   State the necessity of welding.
6.2.   Classify the welding processes.
6.3.   State the advantages and limitations of welding.
6.4.   Explain the principle of arc welding.
6.5.   Identify the tools and equipment of Arc welding.
6.6.   Choose the proper electrodes for given metals.
6.7.   Explain the principles of gas welding.
6.8.   Identify the tools and equipment of oxy-Acetylene Welding.
 6.9.   Explain different welding procedures in arc and gas Welding.
6.10.   Define the terms soldering & brazing.
6.11.   Differentiate soldering from brazing.
6.12.   Explain the principles of soldering & brazing.
6.13.   Select correct soldering materials for a given job.
6.14.   Explain soldering / brazing techniques.
6.15.   Identify the gas cutting equipment.
6.16.   State the principle of flame cutting.
6.17.   State the relative advantages of flame cutting over other types of cutting.
6.18.   List out various (special) modern welding techniques.
6.19.   State in brief the principle of modern welding techniques.
6.20.   Explain the principle of TIG and MIG welding
6.21.   Know the principles of fabrication and erection of mechanical structures

7. Metrology
7.1.   Identify various linear and angular measuring instruments.
7.2.   Explain the principle of working of (at least 4 types) comparators with sketches.
7.3.   Predict the amount of measuring accuracy using the comparator.
7.4.   Identify the in-accuracies in surface finish.
7.5.   Suggest the surface finish measuring instrument.
7.6.   State the use of measuring microscope.
7.7.   State the principle of working of interferometer.

COURSE CONTENTS

1. Lathe and Lathe Work :
- 1.1. Explain the Working Principle of Lathe -Types of Lathe
- 1.2. Constructional details of   Engine lathe with line diagram
- 1.3. Specifications of Lathe,
- 1.4. Brief explanation of the turning operations-Turning, facing, thread cutting knurling, forming drilling, boring, reaming, key way cutting.,
- 1.5. Taper turning methods – form tool methods, tailstock set-over method, compound rest method, taper turning attachment –
- 1.6. Lathe accessories -, work holding devices and tool holding devices.
- 1.7. Lathe tool terminology –Geometry- Tool signature
- 1.8. Functions of tool angles

2. Production Lathes :
- 2.1. Turret lathe: Sketch – Operation – Advantages.,
- 2.2. Capstan Lathe: Sketch – Operation – Advantages
- 2.3. Comparison of Engine (Centre lathe) , Turret and Capstan lathe.
- 2.4. Semi Automatic lathe – Features
- 2.5. Automatic Lathe – Features
- 2.6. Copying lathe – applications.,

3. Shaping, Slotting, Planning Machines.
- 3.1. Layout of a shaper machine – specifications - working principle – applications
- 3.2. Layout of a Slotting machine – specifications -working principle – applications
- 3.3. Layout of a Planer machine – specifications -working principle – applications
- 3.4. Machining operations on the above machines – illustrations
- 3.5. Work holding and tools holding devices (Basic principles only. Sketches not included)
- 3.6. Driving mechanisms - Quick return arrangement: Crank & slotted lever mechanism – Whitworth mechanism – Hydraulic drive.

4. Broaching Machines
- 4.1. Introduction to broaching - Types of broaching machines – Horizontal type (Single ram & duplex ram) Vertical type, Pull up, pull down, and push down
- 4.2. Elements of broach tool, broach teeth details – nomenclature – types –
- 4.3. Tool materials

5. Cutting Fluids & Lubricants
- 5.1. Introduction. - Types of cutting fluids, Fluids and coolants required in turning, drilling, shaping, sawing & broaching,
- 5.2. Selection of cutting fluids, methods of application of cutting fluid.
- 5.3. Classification of lubricants (solid, liquid, gaseous),Properties and applications of lubricants.

6. Welding
- 6.1. Introduction - Advantages and limitations of welding
- 6.2. Classification of welding processes (IS 812), Principles of Arc Welding. ,Arc welding equipment
- 6.3. Choice of electrodes for different metals.

6.4. Principle of gas (Oxy – acetylene) welding ,Equipment of gas welding, Welding techniques (viz. Leftward, rightward etc.,),

6.5. Soldering and Brazing techniques. Types and applications of solders & fluxes ,

6.6. Various flame cutting processes. Advantages and limitations of flame cutting

6.7. Modern welding methods, (Submerged, ultrasonic, welding),

6.8. MIG & TIG Welding, Principle of thermit welding.

6.9. Fabrication and erection of mechanical structures *(NOTE : The subject teacher should organise an industrial visit to familiarise the student with the principles of fabrication and erection of mechanical structures)*

7. Metrology.

7.1. Linear measurement- Slip gauges and dial indicators,

7.2. Angle measurements: Bevel protractor, Sine Bar, Angle Slip Gauges

7.3. Comparators: a) Mechanical   b) Electrical   c) Optical   d) pneumatic

7.4. Measurement of surface roughness: methods of measurements by   Comparison, tracer instruments and by interferometer

7.5. Measuring Microscope - Interferometer

REFERENCE BOOKS

1. Welding Technology   Little
2. Elements of Work Shop Technology vol. I & II   Hazra Choudry
3. Engineering Metrology   Jain
4. Manufacturing technology   P N Rao (MGH Pub)
5. Welding Technology   Parmar,

Subject Title	:	Basic Electrical Engineering & Electronics
Subject Code	:	M-305
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	Unit Test bifur-cation
1.	Electrical engineering fundamentals	15	26	02	2	Unit Test – I Up to 3.9 of objectives
2.	D.C. Machines	15	21	02	1½	
3.	A.C. Fundamentals & A.C. Machines	20	34	03	2 ½	
4.	Semi Conductors	10	13	01	1	Unit Test - II
5.	Electrical measuring instruments & Safety procedures	15	16	02	1	
	Total	**75**	**110**	**10**	**08**	

OBJECTIVES

Up on completion of course the student shall 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 Kirchhoff ' s laws.
    1.5   Simple Problems on the above.
    1.6   Define
        a.   Magnetic field strength
        b.   Flux
        c.   Permeability
        d.   Reluctance
    1.7   Define
        a.   Electric field
        b.   Electric field intensity
        c.   Permittivity
    1.8   State capacitance.
    1.9   State Faradays laws of Electro Magnetic Induction. (no problems)
    1.10   Explain dynamically and statistically induced E.M.F. (no problems)
    1.11   State Lenz's Law. (no problems)
    1.12   Explain Fleming's right hand rule. (no problems)
    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.

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 the 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 Sketch the connection of welding generator
- 2.7 Explain the principle of operation of D.C. Motor.
- 2.8 (a) List out types of motors.
  (b) Draw Schematic diagram of each type.
- 2.9 (a) Explain back e.m.f.
  (b) State the relation between currents and voltages.
- 2.10 Write formula for speed of D.C. Motor in terms of supply voltage, current and flux.
- 2.11 Explain speed control of D.C. Motors.
  (a).. Field control (b). Armature control
- 2.12 List the applications of D.C. motors

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 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) series circuit.
- 3.7 Explain poly phase and 3 phase system.
- 3.8 Explain phase difference in 3 phase system.
- 3.9 State Star-Delta connection.
- 3.10 Explain the Construction & working principle of alternator.
- 3.11 State frequency and speed relations.
- 3.12 Explain working principle of transformer And rating of transformer.
- 3.13 Write relation between turns ratio, Voltage ratio and current ratios
- 3.14 Describe with sketch a welding Transformer.
- 3.15 Explain three phase induction motor working Principle.
- 3.16 Explain constructional features of – 3 phase Induction motors.
  - a. Squirrel cage induction motor.
  - b. Wound rotor induction motor.
- 3.17 State the types of Starters used for A.C.Machines
- 3.18 Explain forward and reverse running of Induction motor.

3.19   State the application of 3 phase induction Motor.
3.20   Explain the working principle of single Phase induction motor.
3.21   List out types of single phase induction Motors.
3.22   Sketch circuit diagram for single phase Induction motors.
3.23   Explain forward and reverse running of Single phase induction
        motor.
3.24   Applications of single phase induction Motors.

4.0   Understand the Principles of Semi-Conductor Devices.
4.1   Classify materials as conductor, semi-conductors and insulators.
4.2   Distinguish between intrinsic and extrinsic semiconductors.
4.3   Describe the formation of P- type and N- type materials.
4.4   Identify majority and minority carries in P&N type materials.
4.5   Explain the formation of PN Junction diode.
4.6   Describe the working of PN junction diodes with forward bias & reverse bias.
4.7   Understand the working of PNP & NPN transistors
4.8   Draw the different transistor configuration.
4.9   Sketch the input & output characteristics of C.B., C.E & C.C.
         configuration.
4.10   Describe the operation of Zener diode.
4.11   Distinguish between Zener & Avalanche break – down.
4.12   Explain the operation of LED, LCD & the materials used.

5.0   Understand Electrical Measuring Instruments and Safety Procedures.
5.1   Explain construction and working principle of moving Coil ammeter and volt meter.
5.2   Explain construction and working principle of moving iron ammeter and voltmeter.
5.3   Explain construction-working principle of dynamometer type wattmeter.
5.4   Explain construction and working principle of A.C. single phase induction type energy
         meters.
5.5   Sketch connection diagram of single phase energy meter with load.
5.6   Explain effect of electrical shock and burn.
5.7   State procedure to be adopted in case of electric shocks.
5.8   State purpose of earthling of electrical equipment and machinery.
5.9   Describe the procedure for pipe earthling.

COURSE CONTENT

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 – Simple problems.
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   Energy stored in a magnetic field.
        .
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) 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) Speed control – field and armature control.
e) 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 Single Phase A.C. Series 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) List the types of Starters used in A.C.machines.
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 Semi – Conductors.
4.1 Semi – conductors – N-Type, P-type.
4.2 Behaviour of PN Junction diode
4.3 Introduction of PNP, NPN Transistors.
4.4 Transistor configuration – Zener diodes.
4.5 Basic Concepts of LED & LCD

5.0   Electrical Measuring Instruments & Safety Procedures

    5.1   Construction and principle of operation of moving coil permanent magnet type ammeter and voltmeter and moving iron ammeter and voltmeter.

    5.2   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

    5.3   Safety Procedures.
- a) Effects of shock and burns.
- b) Procedures to be adopted in case of electrical shocks.
- c) Earthing of electrical equipments.

REFERENCE BOOKS

1.	B.L.Theraja.	-	A Text Book of Electrical Engg. and Electronics.
2.	V.K. Mehtha.	-	Principles of Electronics
3.	B.R. Gupta	-	Fundamentals of Electrical Engg.
4.	S.L.Uppal	-	A Text Book of Elec.Engg & Electronics.

Machine Drawing

Subject Title	:	Machine Drawing
Subject Code	:	M-306
Periods/ Week	:	06
Periods/Semester	:	90

TIME SCHEDULE

Sl.No	Major Topics	Periods	Weightage of Marks	Short answer Questions	Essay type Questions
1	Introduction	06	-	-	-
2	Fastening Devices	18	10	02	-
3	Assembly Drawings	39	80	-	02
4	Piping Layouts and Joints	15	05	01	-
5	Welding Fabrication Drawings	12	05	01	-
	Total	**90**	**100**	**04**	**02**

Note:- In the end examination, candidate has to answer all questions in Part- A and one question out of two in Part-B

I.S/B.S latest specification should invariably be followed in all topics.

OBJECTIVES

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

1.0 Understand the importance of machine drawing
   1.1. Know the importance of Machine drawing.
   1.2. Review of 1st angle and 3rd angle Projections
   1.3. Review of Orthographic Projections and Sectional Views.

2.0 Know about fastening devices
   2.1. Draw the standard thread profiles.
   2.2. Draw bolted connections to standard proportions.
   2.3. Draw different types of screws.
   2.4. Draw different types of rivets and riveted connections.
   2.5. Draw different types of keys and cotters.

3.0 Understand the assembly drawing practice and procedure
   3.1. List the sequence of steps for preparing assembly drawing.
   3.2. Practice the assembly drawing for the given components drawing.
   3.3. Prepare the list of parts.

4.0 Understand the piping layouts and joints.
   4.1. State the distinction between pipes and tubes.
   4.2. Identify the common components of a piping layout.
   4.3. Identify the conventional symbols used for the various components of piping layout.
   4.4. Prepare single line and double line diagrams of piping layouts.
   4.5. Draw the assembly drawing and sectioned views of pipe joint.
   4.6. Explain the use of packing material in joint.

5.0 Appreciate the welded fabrication drawing.
   5.1. Identify the different types of welds and their symbolic representation as per B.I.S., SP-46-2003
   5.2. Identify the elements of welding symbol and their standard location on the symbol.
   5.3. State welding process to be used, surface contour and finish of weld when given in symbolic form.
   5.4. Practice the Preparation of working drawing of welded fabrications.

COURSE CONTENT

1.0 Introduction
   1.1. Importance of Machine Drawing.
   1.2. Brief revision of 1st and 3rd angle projections
   1.3. Understand the concepts of Orthographic projections and Sectional views.

2.0 Fastening Devices
   2.1. Temporary and Permanent fastenings and their areas of application-thread nomenclature, forms of screw thread profiles, Metric, B.A., Acme, Knuckle, etc.
   2.2. Bolts and Nuts: Specification of bolts and nuts, Different types of bolted joints (like using through bolts, studs, screws etc.,) in different applications. Purpose of lock nuts and their Types.
   2.3. Keys and cotters: Types of keys and cotters: Difference between key and cotter -uses.
   2.4. Rivets and Riveted joints: Types, proportions and specification of rivets: Different types of riveted joints: Lap, Butt-single row, double row etc., chain and zigzag riveting – calculation of diameter of rivet: Pitch and arrangement of rivets in row – use of standard proportions.

Drawing Plate: 1
   1. Exercise on Orthographic projections and Sectional views.
   2. Thread Nomenclature and forms of screw thread profiles.
   3. Exercises in drawing – bolted connections using standard proportions.
   4. Drawing of various types of lock nuts & types of keys indicating their proportionate dimensions.
   5. Exercise in drawing riveted joints using standard proportions: Single row, Double row (chain and zigzag) in lap and butt joints (single & double strap).

3.0 Assembly Drawings
   3.1. Need and functions of assembly and detailed drawings.
   3.2. Steps in preparing assembly drawings.
   3.3. Bill of materials and parts list.
   3.4. Exercises in preparing assembly drawings of commonly available engineering components.
   3.5. **Drawing Plate: 2**

Draw the views / sectional views of

Socket and spigot joint	Sleeve and cotter joint	Stuffing box
Knuckle Joint assembly	Bush Pin type flanged coupling	Muff coupling (solid & split)
Universal coupling	Foot step bearing	Plummer block
Eccentric	Lathe tool post	Lathe tail stock
Non return valve		

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 Code, arrow head, weld symbol, supplementary symbol, dimensions of welds, method of welding process, special reference.
5.3. Significance of arrow & position of arrow head significance of reference line as per I.S. standards with reference to fillet, V-Butt and stud welds.
5.4. Supplementary symbols and special instructions: Surface of reference line; as per I.S. standards with reference to fillet, V-Butt and stud welds.
5.5. Dimensions of welds: length, location and spacing of welds as per 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-46-2003.
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. Machine Drawing by **R.B. Gupta.**
6. Engineering drawing practice for schools & colleges: **SP-46-2003**.
7. Machine Drawing by **Bhattacharya** (Oxford Publishers).
8. Machine Drawing by **Ajeeth Singh** (MGH Publishers)
9. Machine Drawing by **N.Siddeswar, Kannaih, Sastri**. (MGH Publishers)

Fuels Lab and Electrical Engineering Lab

Subject Title : **Fuels Lab and Electrical Engineering Lab**
Subject Code : **M – 307**
Total No. of Periods per week : **1 ½ + 1 ½**
Total Periods per Semester : **45**

TIME SCHEDULE (FUELS LAB)

S. No.	Major Components	Periods
1.	Flash & Fire point tests	06
2.	Viscosity measurement	06
3.	Calorific value tests	04 ½
4.	Carbon residue test	03
5.	Calibration of pressure gauge	03
	Total No. Periods	**22 ½**

TIME SCHEDULE (ELECTRICAL ENGG LAB)

S. No.	Major Components	Periods
1.	Identification of Terminals and Insulation resistance of AC & DC Machines usingTest Lamp, Multimeter and Megger	06
2.	Study of DC & AC Machines starters	06
3.	Speed Control of DC Shunt Motor by Field and Armature Control Method	04 ½
4.	Load Test on DC Shunt Motor .	03
5.	Load Test on AC, 3-phase Induction Motor	03
	Total No. Periods	**22 ½**

NOTE:
1. **The course work is compulsory in both labs.**
2. **The Practical end examination consists of 1 ½ hours examination (30 marks) in Fuels Lab and 1 ½ hours (30 marks) examination in Basic Electrical Engineering Lab.**

OBJECTIVES (FUELS LAB)
Up on Completion of the course the student shall be able to:

1.0 Understand the determination of flash and fire point of a given sample of fuel using given apparatus
   1.1 Define the flash and fire points of fuels and lubricants.
   1.2 Distinguish between "open" and "close" tests.
   1.3 Identify the Parts of apparatus
   1.4 Explain the function of each component part
   1.5 Handle the apparatus
   1.6 Manipulate the apparatus
   1.7 Perform the precise operations to determine flash and fire point of given sample of fuel
   1.8 Record the observations
   1.9 List the Precautions and safety procedures
   1.10 Explain the need and scope of the Experiment in industry

2.0 Understand the determination of Viscosity of a given sample of oil using given apparatus
   2.1 Explain the properties of lubricating oil

2.2 Explain the viscosity of oil and its units
2.3 Explain the importance of viscosity as applied to Oils.
2.4 Relate the Absolute viscosity and kinematic viscosity
2.5 Classify the viscometers
2.6 Identify the parts of viscometer
2.7 Handle the apparatus
2.8 Manipulate the apparatus
2.9 Perform the precise operations to record Redwood seconds
2.10 Use empirical formulae to determine the Kinematic &
     Absolute viscosities of given Oil.
2.11 State the effect of temperature on these oil properties.
2.12 Draw the graph between the temperature and viscosities.
2.13 Explain the need and scope of the Experiment

3.0 Understand the determination of Calorific value of a given sample of fuel using given apparatus
3.1 Explain the phenomenon of combustion of fuel
3.2 Explain the calorific value of fuel
3.3 State the differences between higher and lower Calorific
     values of fuels.
3.4 List the types of fuels
3.5 Identify the various Calorimeters for determining the Calorific values of Solid,
     Liquid and gaseous fuels.
3.6 Indentify the parts of Junker's Gas Calorimeter
3.7 Handle the apparatus
3.8 Manipulate the apparatus
3.9 Perform precise operations on bomb, Junker's Gas Calorimeter or Boy's Gas
     Calorimeter to record various parameters
3.10 Determine the Calorific values of solid, liquid and gaseous fuels
3.11 Explain the need and scope of the Experiment

4.0 Understand the determination of amount of carbon residue of a given sample of petroleum product
4.1 Explain the phenomenon of oil evaporation
4.2 Identify the parts conradson tester.
4.3 Handle the apparatus
4.4 Manipulate the apparatus
4.5 Perform precise operations on Conradson tester to record Weights of crucible
4.6 Determine the percentage carbon residue
4.7 Explain the need and scope of the Experiment

5.0 Understand the need and importance of calibration of pressure gauges.
5.1 Define the term pressure
5.2 Explain the function of component parts of Dead weight
     Pressure gauge tester
5.3 State the principle on which the dead weight pressure gauge
     tester works
5.4 Handle the apparatus
5.5 Manipulate the apparatus
5.6 Perform precise operations on Dead weight Pressure gauge
     tester
5.7 Observe and record the pressure due to mass load
5.8 Record the gauge pressure
5.9 Explain the need and scope of the Experiment

OBJECTIVES (Electrical Engineering Laboratory)

Up on Completion of the Laboratory Experiments the student shall be able to:

6.0   Identify of Terminals of the Following DC Machines with the Use of Test Lamp
                (a) DC Shunt Motor   (ii) DC Series Motor (iii) DC Compound Motor
      6.1   Measuring the values of windings of   the Following DC Machines with the Use of Multimeter
                (a) DC Shunt Motor   (ii) DC Series Motor (iii) DC Compound Motor
      6.2   Measuring the values of Insulation Resisitance of the Following DC Machines with the Use of Megger.
                (a) DC Shunt Motor   (ii) DC Series Motor (iii) DC Compound Motor

      6.3   Identify of Terminals of the Following AC Machines with the Use of Test Lamp
                (a) 3-Phase Squirrel Cage Induction Motor   (ii) 3- Phase Slip Ring
                                                        Induction Motor.
      6.4   Measuring the values of windings of   the Following AC Machines with the Use of Multimeter
                 (a) 3-Phase Squirrel Cage Induction Motor   (ii) 3- Phase Slip Ring
                                                          Induction Motor.

      6.5   Measuring the values of Insulation Resisitance of the Following DC Machines with the Use of Megger.
                  (a) 3-Phase Squirrel Cage Induction Motor   (ii) 3- Phase Slip Ring
                                                        Induction Motor.
7.0   Study of Following starters

      7.1   Identifying the terminals and its operating function of Three Point starter .
      7.2   Identifying the terminals and its operating function of Four Point starter .
      7.3   Identifying the terminals and its operating function of DOL (Direct On Line) starter .
      7.4   Identifying the terminals and its operating function of STAR/ DELTA starter .

8.0   SPEED CONTROL OF DC SHUNT MOTOR
      8.1   Able to Draw the Speed Control Characteristics of Dc Shunt Motor By Armature Control method.
      8.2   Able to Draw the Speed Control Characteristics of Dc Shunt Motor By Field flux Control method.

9.0   LOAD TEST ON DC SHUNT MOTOR
      9.1   Draw the Performance Characteristics (Speed, Efficiency) of DC Shunt Motor by load test ..
      9.2   Understand the Use of Load test on DC Shunt Motor.
10.0   LOAD TEST ON   Three Phase Squirrel cage Induction Motor.
      10.1   Draw the Performance Characteristics (Speed, Efficiency) of Three Phase Squirrel cage Induction Motor by load test ..
      10.2   Understanding the Use of Load test on Three Phase Squirrel cage Induction Motor .

COURSE CONTENT

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.
   Determination of Calorific value of gaseous fuel by using Junker's Gas Calorimeter or Boy's Gas Calorimeter
4. Determination of Carbon residue using Conradson's apparatus.
5. Calibration of a pressure gauge using dead weight pressure gauge tester
6. Identification of Terminals and Insulation resistance of AC & DC Machines using Test Lamp, Multimeter and Megger
7. Study of DC & AC Machines starters.
8. Speed Control of DC Shunt Motor by Field and Armature Control Method.
9. Load Test on DC Shunt Motor.
10. Load Test on Three Phase Squirrel cage Induction Motor.

Material Testing Lab

Subject Title : Material Testing Lab
Subject Code : M-308
Periods/Week : 03
Periods/Semester : 45

TIME SCHEDULE

S.NO	EXPERIMENT TITLE	NO. OF PERIODS
1	Tension test	06
2	Compression test	06
3	Shear test	06
4	Impact test	03
5	Hardness test	06
6	Torsion test on springs	06
7	Flexural test on Simply supported beam	06
8	Study of micro structure of Metals and alloys	06
TOTAL		**45**

OBJECTIVES

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

1. Tension test
1.1.   Identify a Universal Testing Machine (UTM)
1.2.   State the specifications of the test specimen as per ASTM / IS standards
1.3.   Conduct a tension test on the given specimen and calculate
        1.3.1. Elastic limit
        1.3.2. Yield point
        1.3.3. Ultimate point
        1.3.4. Breaking Point
        1.3.5. Percentage elongation
        1.3.6. Percentage reduction in area
        1.3.7. Modulus of elasticity
        1.3.8. Tensile strength
1.4.   Plot a stress strain diagram
1.5.   State the significance of the test

2. Compression test
2.1.   Identify a Compression testing machine (CTM)
2.2.   State the specifications of the test specimen as per ASTM / IS standards
2.3.   Conduct a compression test on the given specimen and calculate
        2.3.1. Ultimate point
        2.3.2. Compression strength
2.4.   State the significance of the test

3. Shear test
3.1.   Identify a shear attachment for a UTM
3.2.   Know the procedure of conducting direct shear test on UTM
3.3.   State the specifications of the test specimen as per ASTM / IS standards
3.4.   Conduct a direct shear test on the given specimen using UTM and determine the shear strength of the material.
3.5.   State the significance of the test

4. Impact test
4.1.   Identify Impact testing machines
4.2.   Differentiate between IZOD and CHARPY tests
4.3.   State the specifications of the test specimen as per ASTM / IS standards
4.4.   Conduct IZOD / CHARPY tests on the given specimen, and determine the impact strength
4.5.   State the significance of the test

5. Hardness test
5.1.   Identify Brinell's, Rockwell's and Vicker's hardness testing machines
5.2.   State the specifications of the test specimen as per ASTM / IS standards
5.3.   Conduct Brinell's /Rockwell's /Vicker's hardness test on the given specimen, and determine its hardness
5.4.   State the significance of the test

6. Torsion test on springs
6.1.   Identify spring testing apparatus
6.2.   Apply torsion equation to the case of spring deflection
6.3.   Conduct a deflection test on the given spring tension / compression spring and determine the modulus of rigidity of the spring material
6.4.   State the significance of the test

7. Flexural test on Simply supported beam
7.1.   Identify a beam deflection test apparatus
7.2.   Apply theory of bending to the case of beam deflection
7.3.   Conduct a defection test on the given simply supported beam and determine the modulus of elasticity of the beam material
7.4.   State the significance of the test

8. Study of micro structure of Metals and alloys
8.1.   Know the procedure of preparing a specimen for micrographic examination
8.2.   Identify the tools & equipment required for the above
8.3.   Prepare a specimen for micrographic examination
8.4.   Draw the microstructure of the given specimen after microscopic examination
8.5.   State the significance of the test

COURSE CONTENT
1)   Tension test on mild steel
2)   Compression test on wood
3)   Direct shear test on mild steel
4)   Impact test on mild steel
5)   Hardness test on carbon steel
6)   Torsion test on steel tension spring
7)   Flexural test on wooden beam
8)   Microstructure of a) Brass b) Grey cast iron

Workshop Practice-II

Subject Title	:	**Workshop Practice-II**
Subject Code	:	**M-309**
Periods/Week	:	**03**
Periods per Semester	:	**45**

TIME SCHEDULE

SNo.	Name of Experiment	No of periods allotted
1	**Foundry**	18
	1.1 Solid bearing	3
	1.2 Flange coupling	3
	1.3 Split bearing	3
	1.4 Connecting rod	3
	1.5 V – Pulley	3
	1.6 Gear pulley	3
2	**Machining**	18
	2.1 Plain Turning	3
	2.2 Step Turning	3
	2.3 Taper Turning	3
	2.4 Turning Collars	3
	2.5 Knurling	3
	2.6 Facing	3
3	**Welding**	9
	3.1 Layout of Beads	3
	3.2 Butt joints.	3
	3.3 Lap joints.	3

OBJECTIVES:
1. Obtain skill in the mould preparation
2. Obtain Skill in the casting
3. Obtain skill in the machining Operations
4. Obtain skill in Welding

COURSE CONTENT

1. Foundry (moulding and Casting of)
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)

Practising the following machining operations

2.1 Plain Turning
2.2 Step Turning
2.3 Taper Turning
2.4 Turning Collars
2.5Knurling
2.6 Facing

3. Welding

Practising the welding operations
3.1 Layout of Beads
3.2 Butt joints.
3.3 Lap joints.

DIPLOMA IN MECHANICAL ENGINEERING
SCHEME OF INSTRUCTION AND EXAMINATION
CURRICULUM-16

IV Semester

Sub code	C16-Subjects	No of Periods per week		Total periods per semester	Scheme of Examination			
		Theory	Practice		Duration (Hrs)	Sessional Marks	End Exam Marks	Total Marks
THEORY								
M-401	Engineering Materials	6		90	3	20	80	100
M-402	Hydraulics and Fluid Power Control Systems	6		90	3	20	80	100
M-403	Thermal Engineering II	6		90	3	20	80	100
M-404	Production technology-II	6		90	3	20	80	100
M-405	Design of Machine Elements	6		90	3	20	80	100
PRACTICAL								
M-406	Production Drawing		3	45	3	40	60	100
M-407	Hydraulics & Fluid Power Control Systems Lab		3	45	3	40	60	100
M-408	Communication Skills		3	45	3	40	60	100
M-409	Thermal Engineering Lab		3	45	3	40	60	100
	T O T A L	30	12	630		240	560	800

Engineering Materials

Subject Title   :   **Engineering Materials**
Subject Code   :   **M-401**
Periods per week   :   **06**
Periods per Semester :   **90**

TIME SCHEDULE

Sl. No	Major Topics	No. of Periods	Weightage of Marks	Short answer Questions	Essay Type Questions	Unit Test bifur- cation
1	Introduction Mechanical properties of engineering materials	05	05	--	½	Unit Test – I upto 5.3 of objectives
2	Testing of materials	10	13	01	01	
3	Structure of Materials	10	13	01	01	
4	Production of Iron and Steel	10	13	01	01	
5	Iron Carbon Equilibrium Diagram	15	16	02	01	Unit Test - II
6	Heat treatment of Steel	12	16	02	01	
7	Ferrous, Non Ferrous Metals and their alloys, composite materials	20	21	02	01 ½	
8	Powder Metallurgy	08	13	01	01	
	Total	**90**	**110**	**10**	**08**	

OBJECTIVES
Up on completion of the course the student shall 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
2.3   Impact strength, and hardness of metals.
2.4   Describe the procedure for Testing Materials by X- Ray, gamma – Ray,
        Magnaflux, Ultrasonic and penetrate 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 dendrite 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 of manufacturing cast iron in Cupola.
4.5   Describe the steps in manufacturing steel by Bessemer process (without sketch),
        L-D process, Open Hearth (without sketch) 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; carburizing, nitriding and cyaniding

7.0   Ferrous, Non-Ferrous Metals and their alloys, Composite materials
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, and 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, phosphor bronze, gun metal, alnico, magnalium, Y alloy, babbit metal.
7.9   Introduction to composite materials

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 CONTENT

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

2.0   Testing of materials
2.1   Destructive testing tests on UTM to determine tensile, compressive and shear strengths
2.2   Hardness Tests on Brinell & Rockwell Testing machines - Vickers test principle only
2.3   Impact test using Izod & Charpy specimen
2.4   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 pudding furnace.
4.4   Cast Iron from cupola.
4.5   Production of steel by Bessemer (without sketch), L.D. process; Open hearth (without sketch) 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, normalizing, hardening, tempering,
6.3   Case hardening processing carburizing, nitriding and cyaniding with specific examples of engineering applications of the above.

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   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   Phosphor bronze, gun metal composition and uses.
7.6   Alnico, magnalium, Y alloy, babbit metal composition and properties.
7.7   composite materials definition, application, terminology, types of composites

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

Powder Metallurgy   T.T.T.I, ECH

Material Science   Raghavan.

Physical Metallurgy   Avner

Engineering Metallurgy   T.T.T.I(S.R), ECH

Hydraulics & Fluid Power Control Systems

Subject Title	:	**Hydraulics & Fluid Power Control Systems**
Subject Code	:	**M-402**
Periods/Week	:	**06**
Periods per Semester	:	**90**

TIME SCHEDULE

S.No	Major Topics	No. of Periods	Weightage of Marks	Short answer Questions	Essay Type Questions	Unit Test Syllabus
1	**Properties of fluids**	10	13	1	1	Unit Test - I
2	**Flow of Liquids**	10	13	1	1	
3	**Flow of liquids through pipes**	10	13	1	1	
4	**Impact of Jets**	10	13	1	1	
5	**Hydraulic Turbines**	10	13	1	1	Unit Test - II
6	**Hydraulic Pumps**	10	13	1	1	
7	**Oil power Hydraulics**	15	16	2	1	
8	**Pneumatics**	15	16	2	1	
	Total	**90**	**110**	**10**	**08**	

1. Properties of fluids
Understand the Fluid properties
1.1   Define fluid
1.2   Classify fluids
1.3   Distinguish between compressible (gases) and incompressible (liquids) fluids
1.4   Distinguish between ideal and real fluids
1.5   State the various units used in fluid mechanics
1.6   Define various properties of fluids and state their units
1.7   Define intensity of pressure
1.8   State units for pressure
1.9   State Pascal's law
1.10 Differentiate between gauge, absolute and vacuum pressures
1.11 Principle and working of bourdon pressure gauge
1.12 Solve problems on pressure measurement by U tube and differential manometers

2. Flow of Liquids
Understands the law of continuity and conservation of Energy in respect of liquids
2.1   Classify fluid flow
2.2   Distinguish between laminar flow and turbulent flow
2.3   Explain the concept of Reynolds number.
2.4   Explain the law of Continuity in case of liquids
2.5   Explain laws of conservation of Energy
2.6   Explain the various types of energies and the   total energy.
2.7   Explain the velocity of a flowing liquid
2.8   Write the discharge equation and equation of continuity of flow.
2.9   State Bernoulli's equation
2.10 Explain the working principle of venturimeter, pitot tube, water and current meters
2.11 Define Co-efficient of Velocity (Cv), Co-efficient of Contraction (Cc), Co-efficient of discharge (Cd).
2.12 Solve problems (simple) on law of continuity, Bernoulli's equation, Venturimeter

3. Flow of liquids through pipes
Comprehend power transmission through liquids, flowing in the pipes

3.1 List various losses when liquid flows through pipes
3.2 State laws of fluid friction
3.3 Write the equations for loss of head due to friction in pipes - Darcy's and chezy's formulae
3.4 List various minor losses in pipe flow
3.5 Explain the pipes in series (compound pipe) and equivalent pipe
3.7 Calculate the velocity of flow, discharge and diameter of pipes connecting two reservoirs
3.8 Explain the function of siphon and give reason for limiting the height of the pipes
3.9 Explain how power can be transmitted through pipes carrying liquid under pressure
3.10 Write the condition for maximum power through pipes
3.11 Solve simple problems on power transmission through pipes

4. Impact of jets
Analyse forces, work done and efficiency due to the impact of jets
4.1 Derive expression for force of jet on fixed vertical flat plate, fixed inclined flat plate, and 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 Derive the expressions for work done, power and efficiency in the above
4.5 Solve simple problems related to the above

5. Hydraulic Turbines
Explain the working of Hydraulic turbines
5.2 Draw the layout of a hydroelectric power station
5.3 Classify water turbines on different criteria
5.4 Explain the construction details and working of Pelton wheel
5.5 Explain the construction details and working of Francis turbine
5.6 Explain the construction details and working of Kaplan turbine
5.7 Explain the draft tube theory
5.8 Explain the governing of water turbines with a legible sketch
5.9 Write the formulae for work done and efficiency of Pelton wheel turbine
5.10 Write the formulae for work done and efficiency of Francis turbine
5.11 Solve simple problems on water turbines

6. Hydraulic Pumps
Explain the working of reciprocating and centrifugal pumps
6.1 Explain the function of hydraulic pumps
6.2 Classify hydraulic pumps
6.3 Explain the principle of operation of reciprocating pumps
6.4 Describe the constructional details of single acting pump with the legible sketch
6.5 Describe the constructional details of double acting pump with the legible sketch
6.6 Explain the concept of slip in a reciprocating pump
6.7 State the effect of velocity and acceleration of fluids in suction and delivery pipes
6.8 Explain the principle of air vessel with respect to reciprocating pump
6.9 Solve simple problems on power required to drive reciprocating pump
6.10 Explain the principle of operation of centrifugal pumps with a legible sketch
6.11 Compare centrifugal pump with a reciprocating pump
6.12 Appreciate the importance of priming in centrifugal pump
6.13 Explain the phenomenon of cavitations and state its effect
6.14 Write the expressions for static and man metric head of centrifugal pump
6.15 Write the formula for work done at the impeller of centrifugal pump
6.16 Explain the various losses and efficiencies of a centrifugal pump

6.17   Solve simple problems on centrifugal pumps

7. Oil Power Hydraulics
Understands the working of basic components of Oil power systems
7.1   List the various applications of oil power systems (Hydraulic brake system, Hydraulic press, Hydraulic shock absorber)
7.2   Know the Basic Components of oil Power system in a hydraulic circuit
7.3   Recognize Symbols of various elements in a Hydraulic circuit
7.4   Explain the working and construction of gear, vane and piston pumps.
7.5   Explain the classification of hydraulic actuators.
7.6   Describe the construction and working of hydraulic actuators (Single Acting, Double Acting, Telescopic and Tandem)
7.7   List different types of valves used in fluid power
7.8   Describe the working and construction of direction control valves
(Ball type Check valves, Shuttle valves), Operation of   Two-way valves, Three-way valves, Four-way valves
7.9   Describe the working and construction of simple pressure relief valve, pressure reducing valve
7.10   Describe the working and construction of various flow control valves (needle-type flow-control valve, pressure-compensated flow-control valve)

8. Pneumatics
Understands the working of basic components of pneumatic power systems

8.1   Identify and appreciate the application of pneumatic power systems
8.2`   Compare oil and pneumatic power systems
8.3   Know the Basic Components in a pneumatic circuit
8.4   Recognize Symbols of various elements in a pneumatic circuit
8.5   Explain Principle and working of Filter, Regulator, Lubricator, Muffler, principle of Air control Valves (Two-way, two-position valves, Four-way, two-position valves)
8.6   Study the seals used in the Pneumatic actuators
8.7   Classify the various types of Pneumatic actuators
8.8   explain the principle and working of Pneumatic circuits for control of single acting cylinders and double acting cylinders
8.9   Know the differences between hydraulic and pneumatic power systems

Course Content

1. Properties of fluids
Definition of fluid; Classification of Fluids: Ideal and Real fluids; Newtonian and Non-Newtonian fluids; Compressible and Incompressible fluids; Fluid properties: Density, specific weight, specific gravity, Specific Volume, viscosity surface tension, compressibility, Bulk Modulus and capillarity; Concept of pressure: Pascal's law. Atmospheric, Vacuum, Gauge and absolute pressures; Measurement of pressure: piezo-meter. U-Tube - manometer, differential manometer and bourdon pressure gauge; Simple problems on properties and pressure measurement;

2. Flow of Liquids

Types of fluid flow- Steady and unsteady flow, Uniform and Non-uniform flow, One,Two and Three dimensional flow, Rotational and irrotational flow, Laminar and Turbulent flow; Concept of Reynold's Number; Basic Principles(Laws) of Fluid Motion: Continuity, Energy and Momentum of liquids; Pressure, potential and kinetic energies of liquids, total energy; Continuity equation for one-dimensional flow. Solving of simple problems based on continuity equation. Bernoulli's equation; Problems on Bernoulli's Equation, Venturi meter and Pitot tube; Definition of C_v, C_c, and C_d ;

3. Flow of liquids through pipes

Major energy losses: Laws of fluid friction. The equations for loss of head in pipes due to friction- Darcy's and Chezy's formula (without Minor losses in pipe flow, problems on pipe friction; Minor energy losses; Hydraulic gradient and total energy lines, Pipes in series and parallel, Equivalent pipes, Siphon, power transmission through pipe, Expressions of transmission efficiency, condition for maximum efficiency; Simple problems on power transmission through pipes and efficiency of transmission;

4. Impact of jets

Derivation of formulae for the force, work done and efficiency in case of jet striking on a) Fixed vertical flat plate) Fixed inclined flat plate c) Moving flat plate d) Moving Inclined flat plate e) Series of flat plates fixed on the rim of a wheel f) At the centre and at the tip of a fixed curved blade g) at the centre and at the tip of a moving curved blade; Simple problems on the above cases;

5. Hydraulic Turbines

Introduction to hydraulic Turbines; Hydro-electric power stations; line sketch showing layout of hydro-electric power plant; Classification of turbines; Working principle of Pelton wheel, Work done and Efficiencies of Pelton wheel; Working principle of Francis turbine, and Kaplan turbine; Simple Problems on power & efficiency of Francis and Kaplan turbines;

6. Hydraulic Pumps

Classification of pumps; Principle and of operation of a reciprocating pumps (Single acting, double acting pumps); Effect of velocity and acceleration of fluids, in suction and delivery pipes (without proof); Air vessel; Expression for theoretical power required to drive the pump (without proof). Simple problems related to above. Coefficient of discharge, slip, % of slip and negative slip;

Principe and operation of centrifugal pump; Comparison between Reciprocating and Centrifugal pumps; Priming; Work done by the impeller; Static head, Manometric head; Efficiencies- Manometric efficiency, volumetric efficiency, Mechanical efficiency and Overall efficiency; Cavitation and its effect; Simple problems on work, power and efficiency;

7. Oil Power Hydraulics

Basic Components of oil Power system; Applications; Principle and working of pumps (Gear Pumps, Vane Pump and Piston Pump) used in the oil power systems; Hydraulic Actuators (Single Acting, Double Acting, Telescopic and Tandem); Direction Control Valves; Pressure Control Valves; Flow Control Valves;

8. Pneumatics

Basic Components of Pneumatic Power system; Applications (Vehicle door operation system, Pneumatic work holding devices, pneumatic braking system); Principle and working of Filter, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust valves, Pneumatic actuators, Pneumatic circuits for control of single acting cylinders and double acting cylinders. Comparison of hydraulic power systems with pneumatic power systems;

REFERENCE BOOKS

1.   Fluid power with applications by Anthony Esposito - Printice Hall of India
2.   Fluid power control - NPTEL Web course
3.   Pneumatics by SRIHARI RAO
4.   Pneumatic controls by FESTO
5.   Fluid Power Pneumatics by ALAN H. JOHN
6.   Pneumatics by FLIPPO
7.   Pneumatics By TTI
8.   Hydraulics & Pneumatics by RAY & RAO
9.   Fluid Power & Pneumatics by AUDEL Series
10.   Pneumatic Systems: Principles and Maintenance-S.R Majumdar
11.   Oil Hydraulic Systems: Principles and Maintenance-S.R Majumdar

Thermal Engineering-II

Subject Title	:	**Thermal Engineering-II**
Subject Code	:	**M-403**
Periods/Week	:	**06**
Periods per Semester	:	**90**

TIME SCHEDULE

S. No.	Major Topics	Periods	Weightage of Marks	SAQ	EAQ	Unit Test Syllabus
1	Properties of steam	12	13	1	1	Unit Test - I
2	Steam Generators	12	13	1	1	
3	Thermodynamic Processes on steam	16	16	2	1	
4	Steam Nozzles	10	13	1	1	
5	Steam Turbines	16	16	2	1	Unit Test - II
6	Gas Turbines	08	13	1	1	
7	Jet Propulsion	08	13	1	1	
8	Elements of Automobile transmission	08	13	1	1	
	T O T A L	**90**	**110**	**10**	**8**	

OBJECTIVES

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

1. Properties of steam
1.1. State the industrial uses of steam
1.2. Draw a T-h diagram for steam showing, saturated liquid line, saturated vapour line, liquid region, vapour region, wet region, superheat region, critical point, saturated liquid, saturated vapour
1.3. Define saturation temperature, saturated liquid, sensible heat, latent heat, wet steam, dryness fraction, wetness fraction, saturated steam, superheated steam, degree of superheat
1.4. Write expressions for specific volume, specific enthalpy, specific external work of evaporation, specific internal energy, internal latent heat, specific entropy, of wet / dry / superheated steam at a given pressure or temperature
1.5. Read steam properties from saturated steam (temperature / pressure tables)
1.6. Read steam properties from superheated steam tables
1.7. Read Mollier chart and obtain the properties of a given sample of steam
1.8. Solve problems on properties of steam using steam tables / Mollier chart

2. Steam Generators
2.1. State the industrial uses of boilers
2.2. Classify steam boilers and give practical examples to each type
2.3. Differentiate between water tube and fire tube boilers
2.4. Differentiate between high pressure and low pressure boilers
2.5. Define boiler mounting

2.6.   State the functions of popular boiler mountings - pressure gauge, water level indicator, fusible plug, blow down cock, stop valve, safety valve
2.7.   Define boiler accessories
2.8.   State the functions of popular boiler accessories - feed pump, economiser, super heater and air pre-heater
2.9.   State the features of high pressure boilers
2.10.   Illustrate the working of a Lamont steam generator
2.11.   State the features of supercritical boilers
2.12.   Illustrate the working of a Benson boiler
2.13.   Differentiate between steam traps and steam separators
2.14.   Illustrate the location of steam traps and steam separators in a steam circuit
2.15.   State the features of stoker boilers
2.16.   State the features of FBC boilers
2.17.   Define boiler draught and state its necessity
2.18.   Illustrate natural, forced, induced and balanced draught systems
2.19.   Compare artificial and natural draught systems
2.20.   Compare induced and forced draught systems
2.21.   Define Actual evaporation, Equivalent evaporation, Factor of equivalent evaporation, Boiler horse power and Boiler efficiency of boilers
2.22.   Write expressions for Actual evaporation, Equivalent evaporation, Factor of equivalent evaporation, Boiler horse power and Boiler efficiency
2.23.   Solve simple problems on estimation of the above boiler performance parameters from test data

3.   Thermodynamic Processes on steam
3.1.   Solve problems on calculation of changes in specific volume, specific enthalpy, specific internal energy, specific entropy; and calculation of external work done and heat transferred, for the following processes on wet / saturated / superheated steam
       3.1.1. Isochoric process
       3.1.2. Isobaric process
       3.1.3. Hyperbolic process
       3.1.4. Isothermal process
       3.1.5. Isentropic process
       3.1.6. Throttling process
       3.1.7. Polytropic process
3.2.   Represent the above processes on h-s and T-s diagrams of steam
3.3.   Illustrate the experimental determination of dryness fraction of steam using separating and throttling calorimeter

4.   Steam Nozzles
4.1.   Differentiate between a nozzle and a diffuser
4.2.   Classify nozzles
4.3.   Illustrate a convergent-divergent nozzle, and explain the reason for its shape
4.4.   Represent the steam flow through a convergent-divergent nozzle on Mollier chart
4.5.   State the conditions under which the divergent portion acts as a nozzle
4.6.   Write expression for velocity of steam at the exit of nozzle in terms of heat drop with and without friction
4.7.   Solve simple problems on estimation of steam velocity at the exit of a nozzle
4.8.   Define nozzle efficiency
4.9.   Define critical pressure ratio and state its significance
4.10.   Solve simple problems on calculation of cross section areas at throat and exit for maximum discharge through a nozzle
4.11.   State the effect of friction in nozzles
4.12.   Explain the concept of super saturated flow in nozzles
4.13.   Illustrate the working of a steam jet injector

5. Steam Turbines

5.1.   Illustrate Rankine cycle on p-V and T-s diagrams
5.2.   Identify the operations of a boiler, turbine, and condenser on a Rankine cycle
5.3.   Define a steam turbine
5.4.   Classify steam turbines with practical examples
5.5.   Compare impulse and reaction turbines
5.6.   Illustrate the working principle of a De-Laval turbine
5.7.   Illustrate the variation of steam pressure and velocity across a single stage impulse turbine
5.8.   Draw the velocity triangles of a De-Laval turbine
5.9.   Write expressions for work done, axial thrust, tangential thrust, blade efficiency, nozzle efficiency, stage efficiency of De-Laval turbine
5.10. Solve simple problems on determination of work done, axial thrust, tangential thrust, blade efficiency, nozzle efficiency, stage efficiency of De-Laval turbine
5.11. State the necessity of reducing rotor speeds of De-Laval turbine
5.12. Define compounding of turbines and name the various types of compounding
5.13. Illustrate the pressure, velocity, and pressure-velocity types of compounding
5.14. Explain the reaction principle and identify it as one of the methods of reducing rotor speeds
5.15. Illustrate the working principle of a Parson's Reaction turbine
5.16. Illustrate the variation of steam pressure and velocity across a Parson's Reaction turbine
5.17. Draw the velocity triangles of a Parson's Reaction turbine
5.18. Write expressions for work done, axial thrust, tangential thrust, diagram efficiency, stage efficiency, degree of reaction and blade height of a Parson's Reaction turbine
5.19. Solve simple problems on determination of work done, axial thrust, tangential thrust, diagram efficiency, stage efficiency, degree of reaction and blade height of a Parson's Reaction turbine
5.20. Define a condenser and state its functions in a steam power plant
5.21. Classify steam condensers
5.22. Illustrate the working of a Shell and tube condenser
5.23. State the purpose of bleeding and reheating of steam in steam turbines
5.24. State the necessity of governing steam turbines
5.25. Illustrate Throttle, By-pass and Nozzle control governing methods

6. Gas turbines

6.1.   State the principle of working of a gas turbine
6.2.   Compare gas turbine with steam turbine
6.3.   Compare gas turbine with reciprocating IC engine
6.4.   Classify gas turbines
6.5.   State the applications and limitations of gas turbines
6.6.   Illustrate Joule's cycle on p-V and T-s diagrams
6.7.   Illustrate the working of an open cycle constant pressure gas turbine
6.8.   Illustrate the working of a closed cycle constant pressure gas turbine
6.9.   Compare open cycle and closed cycle gas turbines
6.10. Illustrate Atkinson's cycle on p-V and T-s diagrams
6.11. Illustrate the working of an open cycle constant volume gas turbine
6.12. Compare constant pressure and constant volume gas turbines

7. Jet Propulsion

7.1.   Define jet propulsion
7.2.   State the principle of jet propulsion
7.3.   Name the fuels used for jet propulsion
7.4.   State the applications of jet propulsion
7.5.   Illustrate the working of a turbojet engine
7.6.   State the principle of Ram effect
7.7.   Illustrate the working of a Ram jet engine
7.8.   Define rocket propulsion
7.9.   State the principle of rocket propulsion
7.10. Illustrate the working principle of a rocket engine

7.11. State the applications of rocket propulsion
7.12. Compare jet and rocket propulsions

8. Elements of Automobile transmission
8.1. Illustrate the principal components of an automobile transmission system
8.2. State the functions of the principal components of an automobile transmission system
8.3. Illustrate the working of single plate clutch
8.4. Illustrate the working of a three speed sliding mesh gear box
8.5. State the necessity of an automobile differential
8.6. Illustrate the working of an automobile differential
8.7. Illustrate the rear axle assembly of an automobile

COURSE CONTENT

1. Properties of steam
1.1. Formation of steam under constant pressure –T-h diagram – saturated liquid line – saturated vapour line – liquid region – vapour region – wet region – superheat region - critical point – significance of critical point
1.2. Concepts of saturation temperature, saturated liquid, sensible heat, latent heat, wet steam, dryness fraction, wetness fraction, saturated steam, superheated steam, degree of superheat
1.3. Expressions (without proof) for specific volume, specific enthalpy, specific external work of evaporation, specific internal energy, internal latent heat, specific entropy, of wet, dry and superheated steam at a given pressure
1.4. Introduction to steam tables - using steam tables to calculate the above properties - simple problems on the above
1.5. Introduction to Mollier chart – simple problems on properties of steam applying the chart
1.6. Industrial uses of steam

2. Steam Generators
2.1. Function and use of steam boilers - classification of steam boiler with examples -comparison of water tube and fire tube boilers – comparison of high pressure and low pressure boilers
2.2. Definition for boiler mountings - need – functions of popular boiler mountings viz. pressure gauge, water level indicator, fusible plug, blow down cock, stop valve, safety valve (sketches omitted) - definition of boiler accessories - functions of popular boiler accessories viz. feed pump, economiser, super heater and air pre-heater (sketches omitted)
2.3. Features of high pressure boilers – layout of a Lamont steam generator - working principle - features of supercritical boilers –layout of Benson boiler–working principle
2.4. Need of steam traps and steam separators – functional difference between the two – layout showing their location in a steam line - recent trends in boilers – introductory treatment of stoker boilers and fluidized bed combustion (FBC) boilers
2.5. Definition of boiler draught – types–natural and artificial – types of artificial draught - layout of natural, forced, induced and balanced draught systems – comparison between artificial and natural draught systems – comparison between induced and forced draught systems
2.6. Definitions of boiler performance parameters viz. Actual evaporation, Equivalent evaporation, Factor of equivalent evaporation, Boiler horse power and Boiler efficiency - formulae for the above terms (without proof) - simple direct problems on the above

3. Thermodynamic Processes on steam
3.1. Calculation of changes in specific volume, specific enthalpy, specific internal energy, specific entropy; and calculation of external work done and heat transferred, for the following processes on wet / saturated / superheated steam, with representation on h-s and T-s diagrams:
3.1.1. Isochoric process
3.1.2. Isobaric process
3.1.3. Hyperbolic process

3.1.4.Isothermal process
3.1.5.Isentropic process
3.1.6.Throttling process
3.1.7.Polytropic process
3.2.   layout of separating and throttling calorimeter - experimental determination of dryness fraction of steam using the calorimeter(problems omitted)

4. Steam Nozzles

4.1.   Definitions of nozzle and diffuser - types of nozzles – construction of a convergent-divergent nozzle – reasons for its shape - representation of steam flow through it on a Mollier chart – conditions under which the divergent portion acts as a nozzle/diffuser

4.2.   Expression for velocity of steam at the exit of nozzle in terms of heat drop with and without friction (derivation omitted) – simple problems applying the expression – definition of nozzle efficiency

4.3.   Concept of critical pressure ratio (CPR)in a nozzle – its significance - expression for CPR (derivation omitted) - calculation of cross section areas at throat and exit for maximum discharge – simple problems (frictionless cases only)

4.4.   Effect of friction in nozzles - super saturated flow in nozzles – choking of nozzles

4.5.   Layout of a steam jet injector – working principle – applications

5. Steam Turbines

5.1.   Rankin cycle – p-V and T-s diagrams of the cycle – operations of boiler, turbine and condenser on the cycle - definition of steam turbine - classification of steam turbines with examples – comparison of impulse and reaction turbines.

5.2.   Layout of a De-Laval turbine –working principle– graphs showing variation of pressure and velocity across the turbine – velocity triangles for the turbine

5.3.   Expressions (without proof) for work done, axial thrust, tangential thrust, blade efficiency, nozzle efficiency,stage efficiency of De-Laval turbine – simple problems (without blade friction cases only) using analytical and graphical methods

5.4.   Need for reducing rotor speeds of De-Laval turbine– definition of compounding – methods of compounding - velocity compounding, pressure compounding, compounding for both pressure and velocity (graphical representations only)

5.5.   Reaction principle - layout of a Parson's Reaction turbine – working principle - graphs showing variation of pressure and velocity across the turbine – velocity triangles for the turbine

5.6.   Expressions (without proof) for work done, axial thrust, tangential thrust, diagram efficiency, stage efficiency, degree of reaction, blade height of a Parson's reaction turbine – simple problems (without blade friction cases only) using analytical and graphical methods

5.7.   Definition of a condenser – its necessity in steam power plants – classification of condensers – layout of a shell and tube condenser – working principle - concept of Bleeding and Reheating of steam in steam turbines (Problems omitted)

5.8.   Governing of steam turbines – necessity – types – layout of Throttle, By-pass and Nozzle control governing methods – applications of these methods

6. Gas turbines

6.1.   Principle of a gas turbine – comparison of steam turbines and gas turbines – comparison of gas turbines and a reciprocating IC engines– classification of gas turbines - applications and limitations of gas turbines

6.2.   Joule's cycle – its p-V and T-s diagrams –its application to open cycle constant pressure gas turbine – layout of the turbine - working principle

6.3.   Application of Joule's cycle to closed cycle gas turbine – layout of the turbine – working principle – comparison between open cycle and closed cycle gas turbines

6.4.   Atkinson cycle – its p-V and T-s diagrams –its application to open cycle constant volume gas turbine – layout of the turbine - working principle – comparison between constant pressure and constant volume gas turbines

7. Jet Propulsion
7.1. Definition of Jet propulsion – principle – fuels used - applications
7.2. Layout of a turbojet engine - principle of operation – applications
7.3. Principle of Ram effect – layout of a Ram jet engine - principle of operation – applications
7.4. Definition of Rocket propulsion – fuels used in rocket propulsion- comparison with jet propulsion – layout of a Rocket engine – principle of operation – applications

8. Elements of Automobile transmission
8.1. Layout of automobile transmission system – functions of principal components
8.2. Clutch – its functions - layout of a plate clutch (single plate) – working principle – materials used for its principal components
8.3. Gear box – its functions - layout of a sliding mesh (three speed) gear box – working principle – materials used for its principal components
8.4. Differential – its necessity – layout – working principle – layout of rear axle assembly

Sno	Title of the Book	Author	Publisher
1	Elements of Heat Engines, Vol-I, II, III	R.C. Patel and C.J. Karamchandani	Acharaya Publications
2	Thermal Engineering	R.S.Khurmi	S.Chand
3	Automobile Engineering	Kirpal Singh	Standard Publishers Distributors Delhi

Production Technology-II

Subject title : **Production Technology-II**
Subject code : **M- 404**
Periods per week : **06**
Periods per semester : **:90**

TIME SCHEDULE

SNo.	Major Topics	No. of,Periods	Weightage	SAQ	EAQ	Unit test Bifurcation
1	Milling	14	16	02	01	
2	Gear Making	12	13	01	01	Unit Test- I
3	Grinding and finishing processes	15	16	02	01	
4	Modern Machining Process	09	13	01	01	
5	Plastic processing	12	13	01	01	
6	Press Tools,	10	13	01	01	
7	Jigs and Fixtures	10	13	01	01	Unit Test-II
8	Jig Boring	08	13	01	01	
Total		**90**	**110**	**10**	**08**	

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

1. **Milling**
   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 Explain the different indexing methods
   1.8 Explain the specifications of milling machines.

2. **Gear Making**
   2.1. Identify the different methods of producing gears.
   2.2. Illustrate gear shaping
   2.3. Sketch the gear hob.
   2.4. Identify the various components of hobbing machine
   2.5. Describe the working of the above machine .
   2.6. List out the sequence of operations in generating gear by gear hobbing machine
   2.7. Explain the different methods of finishing & checking gear teeth dimensions
   2.8. Specify the gears
   2.9. Identify the gear materials
   2.10. State the different heat treatment processes applied to gears

3. **Grinding and finishing Processes**
   3.1. Explain the principle of metal removal by grinding
   3.2. Identify different abrasives.
   3.3. Explain the bonds and grinding wheel manufacturing processes
   3.4. Identify the grinding wheel from the standard code (Marking system or designation of wheel)

3.5. State the factors for selecting the grinding wheel
3.6. State the methods of grinding
3.7. Classify the grinding machines
3.8. Illustrate the cylindrical, surface, tool and cutter grinders
3.9. State different finishing processes by grinding.(Honing ,Lapping, Superfinishing)
3.10. Illustrate the principle of electro–plating
3.11. Explain the principle of hot dipping processes namely, Galvanising, tin coating, Parkerizing and anodising
3.12. Describe organic coatings
3.13. State the principles of metal spraying
3.14. State the features of wire process and powder process
3.15. Select the appropriate process for surface roughness a given application.

4. **Modern Machining Processes**
   4.1. Distinguish between non-conventional machining processes and traditional machining
   4.2. State their relative advantages
   4.3. Illustrate principle of working of Ultrasonic Machining
   4.4. Identify the equipment used in U.S.M. processes
   4.5. Illustrate the principle of electric discharge machining (EDM)
   4.6. Illustrate Abrasive jet machining
   4.7. Illustrate Laser beam machining
   4.8. State the principle of chemical machining
   4.9. State their advantages, disadvantages and applications

5. **Plastic Processing**
   5.1. Indicate the principle of manufacturing plastic products
   5.2. Illustrate the methods of moulding methods-injection compression ,transfer moulding
   5.3. Explain the principle of extruding, casting and calendering
   5.4. Identify the different fabrication methods viz., sheet, Forming, blow moulding, laminating and reinforcing of plastics
   5.5. Indicate the principle of machining and welding plastics
   5.6. Know Engineering applications of plastics

6. **Press Tools**
   6.1. Explain Importance of Press Tools
   6.2. Classify presses- based on power and design of frame
   6.3. Illustrate the constructional details of a power press
   6.4. State the meaning of Press size.
   6.5. Explain Press Tools – Punch and die
   6.6. Explain Die-clearance- Die Accessories
   6.7. Understand shear action in die cutting operation – Punc and die clearances, Angular clearance, centre of pressure, cutting forces
   6.8. Explain different types of dies
   6.9. Understand various die operations

7. **Jigs and Fixtures**
7.1. Know the function of Jigs and Fixtures
7.2. State the advantages of Jigs and Fixtures
7.3. Differentiate jigs and fixtures

7.4.   List various types of jigs and their constructional details
7.5.   State general considerations in design of drill jigs
7.6.   State the function of drill bush
7.7.   Identify different types of fixtures and their constructional details
7.8.   Explain basic principle of location
7.9.   Identify different locating methods and devices
7.10.   Understand basic principle of clamping
7.11.   Identify different types of clamps and their constructional details with legible sketches

8. **Jig Boring**
    8.1. Know the situation where jig-boring machines are needed
    8.2. Illustrate the principle of working of a jig boring machine
    8.3. Classify the jig boring machines
    8.4. Illustrate the constructional details of open front machine and cross rail type machine
    8.5. Explain the function of above machines
    8.6. Describe the systems of location of holes

COURSE CONTENTS

1. **Milling**
    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

2. **Gear making**
    2.1. Manufacture of gears – by casting, moulding – stamping - coining – extruding- rolling – Machining
    2.2. Gear generating methods: Gear Shaping with pinion cutter & rack cutter, Gear hobbing
    2.3. Description of gear hob – Operation of gear hobbing machine
    2.4. Gear finishing processes
    2.5. Gear materials and specification
    2.6. Heat treatment processes applied to gears

3. **Grinding and finishing processes**
    3.1.   Introduction – principles of metal removal by Grinding.
    3.2.   Abrasives – Natural & Artificial
    3.3.   Bonds and binding processes: Vitrified, silicate, shellac, rubber, bakelite
    3.4.   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
    3.5.   Standard marking systems: Meaning of letters & numbers sequence of marking – Grades of letters.
    3.6.   Grinding machines – classification: Cylindrical, Surface, Tool & Cutter grinding machine- construction details – relative merits
    3.7.   Principle of centreless grinding
    3.8.   Advantages & limitations of centre less grinding
    3.9.   Finishing by grinding: Honing, Lapping, Super finishing

3.10.   Electroplating – Basic principles – Plating metals – applications
3.11.   Hot dipping: Galvanizing, Tin coating, Parkerising, Anodizing.
3.12.   Metal spraying: wire process, powder process and applications
3.13.   Organic coatings: Oil base Paint, Lacquer base, Enamels, Bituminous paints, rubber base coating
3.14.   Finishing specifications.

4. **Modern Machining Processes**
   4.1. Introduction – comparison with traditional machining
   4.2. Ultrasonic machining - principle – Description of equipment – applications
   4.3. Electric Discharge Machining: Principle – Description of equipment – applications
   4.4. Abrasive jet machining – principle – description of equipment – application
   4.5. Laser beam machining - principle – description of equipment – application
   4.6. Chemical machining- description of equipment- application

5. **Plastics Processing**
   5.1. Processing of plastics
   5.2. Moulding processes-Injection moulding, Compression moulding, Transfer moulding,
   5.3. Extruding,
   5.4. Casting
   5.5. Calendering
   5.6. Fabrication methods-Sheet forming, Blow moulding, Laminating plastics (sheets, rods & tubes),Reinforcing
   5.7. Applications of Plastics

6. **Press Tools**
   6.1.   Introduction
   6.2.   Types of Presses–hand, power, gap, inclinable, adjustable, horn, straight side, pillar presses.
   6.3.   Constructional details of a power press., Press size
   6.4.   Press Tools – Punch and die,
   6.5.   Die Accessories – Stops, Pilots, strippers, Knock outs, pressure pads
   6.6.   Shear action in die cutting operation – punch and die clearance and angular clearance, centre of pressure, cutting forces
   6.7.   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
   6.8.   Sheet metal bending: bending methods, spring back, bend allowance, bending pressure – sketches and empirical formulae
   6.9.   Types of dies meaning of inverted, progressive, compound and combination dies
   6.10.   Material selection for punch and die.

7. **Jigs Fixtures**
   7.1.   Definition of jig
   7.2.   Types of jigs-leaf jig, box and handle jig, template jig, plate jig, Indexing jig, Universal jig, vice jigs -   Explain the constructional details of the above jigs.
   7.3.   General consideration in the design of drill jigs
   7.4.   Explain drill bush
   7.5.   Types of fixtures- vice fixtures, milling fixtures, boring fixtures, grinding fixtures.
   7.6.   Explain the constructional details of the above fixtures.

7.7.   Basic principles of location

7.8.   Explain the locating methods and devices

7.9.   Explain the basic principles of the clamping.

7.10.   Types of clamps- strap clamps, cam clamps, screw clamps, toggle clamps, hydraulic and pneumatic clamps

8. **Jig Boring.** Introduction.-   Jig boring on vertical milling machine. Types jig boring machines-Open front machine. Cross rail type machine constructional details & their working -System of location of holes

REFERENCE BOOKS

1.	Production Technology	-	R.C.Patel,
2.	Production Technology	-	Jain & Gupta.,
3.	Gear Technology	-	Charrathi,
4.	A Text Book of Production Engg	-	Dora,
5.	Tool Design	-	Donaldson
6.	Manufacturing technology	-	Hajra Chowdary Vol I & II

Design of Machine Elements

Subject Title	:	Design of Machine Elements	
Subject Code	:	M – 405	
Periods/Week	:	06	
Periods/Semester	:	90	

TIME SCHEDULE

S. No	Major Topics	Periods	Weightage of Marks	Short Answer Questions	Essay Type Questions	Unit test syllabus
1	Introduction	04	03	01	-	Unit Test - I
2	Bolts, Nuts & Screws	12	13	01	01	
3	Shafts, Keys and Couplings	16	23	01	02	
4	Belts & chains	12	16	02	01	
5	Gears	12	13	01	01	Unit Test - II
6	Bearings	12	13	01	01	
7	Cams	10	13	01	01	
8	Fly wheels & Governors	12	16	02	01	
	Total	**90**	**110**	**10**	**08**	

OBJECTIVES

Up on completion of the course the student shall able to comprehend

1.   Introduction
  1.0   To understand the basic requirements of design.
  1.1   To define the term design.
  1.2   To identify the factors governing design.
  1.3   To state general design procedure.

2.   Bolted Joints
  2.1   Explain screw thread nomenclature and specifications of screw threads
  2.2   To know the strength of screwed fasteners
  2.3   To know the stresses in bolts
  2.4   Design the size of bolt for a given load requirement.
  2.5   Design the size of eye bolt for a given load requirement
  2.6   To draw an eye bolt (not to scale) showing the proportions

3.   Shafts, Keys and Couplings
  3.1   State the functions and types of shafts.
  3.2   Design solid and hollow shafts to transmit a given power a
          given RPM based on strength and rigidity.
  3.3   Design an axle.
  3.4   Design using Rankine's and Guest's theory.
  3.4   Know standard sizes of shafts as per I.S.
  3.5   Explain the function of keys and splines.
  3.6   Name the recommended materials used for keys and splines.
  3.7   Explain the possible ways of failure of a key under load.
  3.8   Design and sketch a rectangular sunk key considering failure against shear and crushing
          for a given torque and also using empirical relations.
  3.9   Write all the proportions of a spline for a given application
          referring tables.

3.10 Know the specifications of parallel, gib-head and taper sunk keys as per B.I.S.

3.11 Explain the function of a coupling.

3.12 Types of couplings

3.13 Design a cast iron flange-coupling (rigid type) for a given torque.

4. Understand the Design of Belts and chain drives

4.1 Explain the selection criteria of various means of power transmission.

4.2 Identify various types of belts.

4.3 Identify different types of drives in belts.

4.4 Design a stepped pulley for a belt drive.

4.5 Compute power transmitted.

4.6 Design belt dimensions for a given power transmission.

4.7 Apply the effect of centrifugal tension in the above cases.

4.8 List the Components of chain drives

4.9 State advantages of chain drives.

4.10 List the types of chains (Design of chain drives omitted)

5. Understand the Design of Gear drives

5.1 Explain the nomenclature of spur gear tooth.

5.2 Identify various tooth profiles of gear.

5.3 Gear tooth design using Lewis equation for static loading only

5.4 List different types of gear trains

5.5 Design different types of gear trains for given velocity ratios

5.6 Explain the applications of gear trains

6. Bearings

6.1 State the function of bearings

6.2 classify the bearings

6.3 Advantages and disadvantages of sliding contact bearings

6.4 select a bearing for given loads using tables

6.5 Design a simple journal bearing using McKee's equation

6.6 Calculate heat generated and dissipated in journal bearing

6.7 Calculate heat generated and dissipated in collar bearing based on uniform pressure and uniform wear

6.8 State advantages and disadvantages of anti-friction bearings (design omitted)

6.9 Illustrate a ball / roller bearing

6.10 Specify a bearing

7. Understand the Design of Cams.

7.1 Explain the features of cam profile.

7.2 Classify the cams.

7.3 Define terms related to cam profile.

7.4 Draw angular - displacement diagram for lift motion for:
   a) Uniform velocity.
   b) S.H.M.
   c) Uniform acceleration & retardation.

7.5 Draw simple cam profiles in above three cases for knife edge and roller followers. (offset followers are omitted)

8. Understand the Design of Fly wheels and Governors

8.1 State the function of flywheel

8.2 Explain the terms related to flywheel

8.3 State the formula for energy stored by flywheel

8.4 Solve simple problems and design of fly wheel

8.5 Explain the function of governor using legible sketch.

8.6 Description of working principle of Watt governor and Porter governor using legible sketch

8.7 Explain the terms – sensitiveness, stability, isochronism, hunting, effort and power of governor (design of governors omitted)

COURSE CONTENT

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 element.

2.   Bolted Joints

Revision of nomenclature, form of threads – specifications.

Strength of screwed fasteners and failure of bolts due to different reasons

stresses due to inital tightening and 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.

Design of eye bolt for a given load and sketching - using empirical proportions, applications of eye-bolt.

3.   Shafts, Keys and Couplings

shafts

Function of shafts and materials used for shafts

Standard sizes of shafts as per I.S.

Design of diameters for solid and hollow shafts to transmit a given power at given rpm.,

a)   based on strength

b)   based on rigidity.

Design of axle.

Design of shaft/axle/spindle on the basis of Rankine's and Guest's theory (simple problems 0nly)

Numerical problems

keys

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 of a spline for a given application using tables.

Couplings : Function of coupling.

Types of couplings.

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 and chain drives

Factors to be considered while selecting the type of drive

Belt drive, types of belt drives; belt materials, belt joints

 length of open and crossed belts (without proof).

Design of stepped pulley belt drive only.

Expression for the ratio of belt 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 considering centrifugal tension. – simple problems
Chain drives –advantages-Types of chains – Roller and silent chains.
(Design of chains omitted)

5. **Gear drives**
Gear tooth terminology – involute and cycloidal profiles
Gear tooth design using Lewis equation for static loading only.
Simple, compound, reverted & Epi cyclic gear trains.
Design of number of teeth for simple, compound and reverted gear trains for a given speed ratio and sketching the arrangement.
Applications of gear trains –
Problems on back gear assembly of lathe – 3- Speed gear box of an automobile.
Description and application of epi-cyclic gear trains (epicyclic gear trains design omitted)

6. **Bearings**
Functions, Types of bearings
Journal bearing – terminology, McKee's Equation, Bearing Modulus
Friction in journal bearing, Friction circle, power lost due to friction in bearings, design of
Thrust bearing - Power lost in friction, flat pivot and flat collar under conditions of uniform intensity of pressure and wear
 Rolling contact bearings – advantages and disadvantages (design of anti friction bearings omitted)
Components of rolling contact bearing
Market or commercial specifications of ball and roller bearings as per BIS standards

7. **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 of 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 edge & 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 axis of the cam shaft (offset followers not included)

8. **Fly wheels and Governors**
Purpose and applications of fly wheels – Definitions of Coefficient of fluctuation of speed and Coefficient of fluctuation of energy.
Turning moment diagram of flywheels
Formula for energy stored by fly wheel (without proof) – simple problems on design of flywheel
Governor – function – types
Explanation of Simple Watt governor and Porter governor
Define the terms like Sensitiveness, Stability, Isochronism, Hunting, Effort and Power of governor (design of governors omitted)

REFERENCES
1. Machine Design - R.S.Khurmi., S Chand &Company
2. Design of Machine Elements - Pandya and Shah, Charotar Publishing House.
3 Design of Machine Elements – V B Bhandari , Tata McGraw Hill.
4 Machine Design – R.K. Jain, Khanna Publications

Production Drawing

Subject Title	:	Production Drawing	
Subject Code	:	M-406	
Period/Week	:	03	
Period per Semester	:	45	

TIME SCHEDULE

S.No	Major Topics	Number of Periods	Weightage of *Marks*		Part-A Questions	Part-B Questions
			Part-A	Part-B (each question)		
1	Introduction to Production Drawing	03	-	-	-	-
2	Limits, Fits & Dimensional Tolerances	06	05	05	01	
	Geometrical Tolerances	03	05	03	01	
3	Surface finish	03	05	03	01	02*
4	Specification of materials & standard components	03	05	04	01	
5	Process sheet	03	-	05	-	
6	Exercises in Production Drawing	24	-	20 (component drawing)		
	Total	45	20	40	04	02

*NOTE :
1. **Candidate has to answer all questions in part- A and one question from Part- B.**
2. **Part B question carries 40 marks and distributed for views, process Sheet, selection of materials, surface finish, limits fits and tolerances.**
3. **Part drawing for maximum two components is to be given under Part-B**

OBJECTIVES

   Up on the completion of the course the student shall be able to

1. **Understand the need of production drawing.**
    1.1   Distinguish the machine drawing from a production drawing.
    1.2   State the factors that govern the preparation of a production drawing.
    1.3   Identify the components of a production drawing.
    1.4   List the function of the component.
    1.5   Prepare the relevant views of the part and dimension the part.
    1.6   Indicate the details of specific processes like, heat treatment, welding, counter boring etc.

2. **Interpret dimension to obtain a fit as per BIS standards.**
    2.1   State definition of fit, allowance and tolerance.
    2.2   Select dimension from standards to give different type of fit for the given mating parts.
    2.3   Compute the fit from tables.
    2.4   Indicate fits on the drawings
    2.5   Importance of geometrical tolerances & Indicating geometrical tolerances on the drawing

3. **Identify the standard symbol and indication added to it, to represent surface finish.**
    3.1   Indicate the roughness grade number and corresponding symbol as per BIS.
    3.2   Indicate surface roughness on drawings.

4.   Interpret and estimate the material requirement.
   4.1   Identify the material of various components.
   4.2   Specify the raw material as per commercial/BIS Standards.
   4.3   Identify the standard part that can be procured directly from the market and specify the part as per commercial/BIS Standards for procurement.

5.   Write the process sheet of production and prepare the number of production drawings.
   5.1   Indicate the sequence of process of production.
   5.2   Specify the relevant tools to obtain the accuracy and finish.
   5.3   Indicate the suitable equipment.
   5.4   Specify the type of measuring instruments to be used to check the prescribed accuracy.

6.   Production Drawing Exercises
   6.1   Prepare exercises on production drawing as mentioned in the contents.

COURSE CONTENT

1.   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.   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 dimensional tolerances.
   Representation of geometrical tolerances.
   Exercises in computing tolerance and representation on the drawings for different types of fits.

3.   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.

4.   Specifications of materials & standard components
   Materials of the parts of the assembly – size of part, estimation of raw material required for a component and specification.
   Standard components (parts) like bolts, nuts, bearings etc. – specification of standard parts.

5.   Process sheet
   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.

6.   Exercises in Production Drawing
   In order to develop the abilities required in the preparation of production drawing in the student, the use of actual production drawing from the local industries as exercises to the students is of vital importance.

Flange Coupling	Universal Coupling	Eccentric
Clapper Block	Connecting rod	Drill jig

Lathe tail stock	Revolving Centre	Knuckle Joint
Plummer Block	Lathe Tool post	Non Return valve
Foot Step bearing	Stuffing box	

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

Dimension 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.

Mark the surface finish symbols with indications added.

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

REFERENCE BOOKS

1.   IS 696 – 1972-Code of Practice for General Engg. Drawing & B.I.S Code – SP . 46. IS 696 – 1988- IS Code on fits and tolerances.
2.   Machine drawing by R.B. Gupta.
3.   Machine Drawing by Siddeswar.
4.   Production Drawing by K.Venkat Reddy
5.   Machine Drawing by Nagpal

Subject Title : **Hydraulics & Fluid Power Control Systems Lab**
Subject Code : **M-407**
Periods/Week : **03**
Periods per Semester : **45**

TIME SCHEDULE

S.No	Experiment Title	No. of periods
1	Venturimeter	03
2	Pipe fricion	03
3	Pelton wheel	03
4	Kaplan turbine	03
5	Francis turbine	03
6	Reciprocating pump	03
7	Centrifugal pump	03
8	Familiarisation with oil power hydraulic controls	12
9	Familiarisation with pneumatic power controls	12
	Total	45

OBJECTIVES

Upon Completion of the Lab the student shall be able to

1.0 Practice the determination of C_d of Venturimeter
1.1 State the practical applications of venturimeter.
1.2 Record the manometric head readings from U-tube manometer
1.3 Record the time taken for collecting discharge by varying the discharge
1.4 Calculate the areas of the pipe and throat of the given venturimeter
1.5 Calculate coefficient of discharge of venturimeter.

2.0 Practice the determination of loss of head in a given pipe
2.1 Measure the length of the given pipe
2.2 Record the manometric head readings from U-tube manometer
2.3 Record the time taken for collecting discharge by varying the discharge
2.4 Calculate the loss of head through the pipe
2.5 Calculate the friction factor

3.0 Practice the determination of Power and Efficiency of Pelton Wheel
3.1 Identify the components of Pelton wheel

3.2 Start turbine by switching on jet of water slowly
3.3 Apply load steadily
3.4 Record load, speed
3.5 Calculate power and efficiency of turbine

4.0 Practice the determination of Power and Efficiency of Kaplan Turbine
4.1 Identify the components of Kaplan Turbine

4.2   Start turbine by giving input water supply
4.3   Apply load steadily
4.4   Record load, speed
4.5   Calculate power and efficiency of turbine

5.0 Practice the determination of Power and Efficiency of Francis Turbine
5.1   Identify the components of Francis Turbine

5.2   Start turbine by switching on jet of water slowly
5.3   Apply load steadily
5.4   Record load, speed
5.5   Calculate power and efficiency of turbine

6.0 Practice the determination of output Power and Efficiency of Reciprocating Pump
6.1   Identify the components of reciprocating pump
6.2   Record the suction and delivery pressures from pressure gauges
6.3   Record the time taken for collecting the discharge
6.4   Record the energy meter readings and calculate input power
6.5   Calculate the output power
6.6   Calculate the efficiency

7.0 Practice the determination of output Power and Efficiency of Centrifugal Pump
7.1   Identify the components of centrifugal pump
7.2   Record the suction and delivery pressures from pressure gauges
7.3   Record the time taken for collecting the discharge
7.4   Record the energy meter readings and calculate input power
7.5   Calculate the output power
7.6   Calculate the efficiency

8.0   Familiarisation with oil power hydraulic controls
8.1 Identify the principal components of oil power hydraulic power circuits
8.2 Understand the principle of working of hydraulic actuator
8.3 Understand the principle of working of hydraulic motor.
8.4 Understand the principle of working of direction control valve
8.5 Understand the principle of working of flow control valve
8.6Understand the principle of working of pressure control valve

9.0   Familiarisation with pneumatic power controls
8.1 Identify the principal components of pneumatic power circuits
8.2 Understand the principle of working of pneumatic actuator
8.3 Understand the principle of working of pneumatic motor.
8.4 Understand the principle of working of direction control valve
8.5 Understand the principle of working of flow control valve
8.6 Understand the principle of working of pressure control valve

COURSE CONTENT
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. Hands on experience on oil power hydraulic trainer
9. Hands on experience on pneumatic power trainer

Communication skills

Subject title	:	Communication skills
Subject code	:	M-408
Periods per week	:	3
Periods per semester	:	45

Introduction :

In the context of globalization , competence in speaking skills is the need of the hour The gap between the needs of the industry and the curriculum can be bridged by enabling the students to hone their speaking and listening skills. This course aims at providing opportunities for practicing speaking.

Time Schedule

Sno.	Topic	Periods	Weightage of marks (End Exam)	Sessional marks	Total
1	Listening I	3	10	10	20
2	Listening II	3			
3	Introducing oneself	3	50	30	80
4	Describing objects	3			
5	Describing events	3			
6	Reporting past incidents	3			
7	Speaking from observation / reading	3			
8	JAM	6			
9	Group discussion	6			
10	Mock interviews	6			
11	Making presentations	6			
		45	60	40	100

Objectives :

On completion of the course the students will be able to

- Strengthen their listening skills
- Strengthen their speaking skills

Competencies and key competencies to be achieved by the student

Topic	Teacher's input/ methodology	Students competence
Listening I Listening II	Pre- Listening –eliciting, pictures While - Listening Post –Listening –project , writing	Identifying the main idea, Identifying specific details, Identifying parallel and contradictory ideas Drawing inferences, Reasoning
Introducing oneself	Kinds of introduction --official/ personal, dynamic vocabulary, Body language, Model introduction, Use of line ups	Use of simple present tense, Sequencing, Appropriate vocabulary

Reporting incidents	Group work /pair work, Elicit, Use of past tense, Student presentations	Use of past tense, Relevant vocabulary
Describing objects	Vocabulary , Use of adjectives, Games—I spy, Group presentations	Use of adjectives, Dimensions,shapes Compare and contrast, Sequence
Describing events	Group work/pair work Use of appropriate tense	Use of appropriate tense, Sequencing

Reporting past incidents	Use of past tense, Vocabulary Student presentations	Use of past tense , sequencing
Speaking from observation/reading	Group work/pair work, Reading techniques ,	Use of past tense, Summarising , evaluating, comprehension
JAM	Effective techniques , Good beginning , conclusion, tips, Use of line ups	Vocabulary, Sequencing, Fluency, Thinking spontaneously
Group discussion	Expressing opinion, body language,	Expressing opinion, agree/ disagree, fluency,Persuasive and leadership skills
Mock interview	FAQs , body language	Role play, body language,
Making presentations	Student presentations	Using charts , pictures, interpreting data, sequencing,PPTs

Communicative methodology (CLT) should be used to create an interactive class. Apart from the suggestions given teachers are free to innovate to use any activity to improve the language competence of students . Attention can also be given to improve the accent and intonation of students.
Note:
* This subject   is a theory subject.
** The workload should be calculated as theory workload.
***Examinations in the subject will be treated as a practical one.

Thermal Engineering Lab

Subject Title   :   Thermal Engineering Lab
Subject Code   :   M – 409
Periods per Week   :   03
Periods per Semester :   45

TIME SCHEDULE

Sno	Name	Number of Periods
1	Study of valve timing diagrams for four stroke engines	03
2	Study of port timing diagrams for two stroke engines	03
3	Performance test on a diesel engine	06
4	Performance test on a petrol engine	06
5	Heat balance sheet on a diesel engine	06
6	Economic speed test on a petrol engine	06
7	Morse test on multicylinder engine	06
8	Volumetric efficiency of air compressor	06
9	Servicing & Maintenance of an automobile engine	03
	T O T A L	**45**

OBJECTIVES

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

1. Study of valve timing diagrams for four stroke engines
1.1.   Identify the inlet and outlet valves of a four stroke IC engine
1.2.   Illustrate the mechanism used for valve operation
1.3.   Draw a hypothetical VTD for four stroke IC engines
1.4.   Draw a practical VTD for four stroke diesel engines
1.5.   Draw a practical VTD for four stroke petrol engines
1.6.   State the effect of valve timing on performance of the engine

2. Study of port timing diagrams for two stroke engines
2.1.   Identify the ports of a two stroke IC engine
2.2.   Draw a hypothetical PTD for two stroke IC engines
2.3.   Draw a practical PTD for two stroke diesel engines
2.4.   Draw a practical PTD for two stroke petrol engines
2.5.   State the effect of port timing on performance of the engine

3.   Performance test on a diesel engine
3.1.   State the scope of performance test on an engine
3.2.   Identify the various components of the test rig
3.3.   Draw the experimental layout of the test
3.4.   List out the tools and equipment required for conducting the test
3.5.   State the observations to be made
3.6.   Calculate the performance parameters – Indicated power, Brake power, Friction power, Mechanical efficiency, Indicated thermal efficiency, Brake thermal efficiency, specific fuel consumption etc.,
3.7.   Draw the performance curves
3.8.   Compare with the ideal performance curves and comment on the performance of the engine

4. Performance test on a petrol engine
4.1. State the significance of performance test
4.2. Identify the various components of the test rig
4.3. Draw the experimental layout of the test
4.4. List out the tools and equipment required for conducting the test
4.5. State the observations to be made
4.6. Calculate the performance parameters – Indicated power, Brake power, Friction power, Mechanical efficiency, Indicated thermal efficiency, Brake thermal efficiency, specific fuel consumption etc.,
4.7. Draw the performance curves
4.8. Compare with the ideal performance curves and comment on the performance of the engine

5. Heat balance sheet on a diesel engine
5.1. State the scope of the Heat balance test on the engine
5.2. State the significance of the test
5.3. Identify the various components of the test rig
5.4. Draw the experimental layout of the test
5.5. List out the tools and equipment required for conducting the test
5.6. State the observations to be made
5.7. Calculate the heat equivalent of brake power, cooling water loses, flue gas loses, radiation loses etc.,
5.8. Draw a heat balance sheet for the engine
5.9. Compare it with that of an ideal engine and comment on the performance of the engine

6. Economic speed test on a petrol engine
6.1. State the significance of the test
6.2. Identify the various components of the test rig
6.3. Draw the experimental layout of the test
6.4. List out the tools and equipment required for conducting the test
6.5. State the observations to be made
6.6. Estimate the range of economic speed for the engine

7. Morse test on multicylinder engine
7.1. State the scope of the test
7.2. Identify various components of the test rig
7.3. Draw the experimental layout of the test
7.4. List out the tools and equipment required for conducting the test
7.5. State the observations to be made
7.6. Calculate the Brake power, Indicated power, Friction power, and Mechanical efficiency of the engine

8. Volumetric efficiency of air compressor
8.1. State the scope of the test
8.2. State the significance of the test
8.3. Identify various components of the test rig
8.4. Draw the experimental layout of the test
8.5. List out the tools and equipment required for conducting the test
8.6. State the observations to be made
8.7. Calculate the volumetric efficiency of the compressor
8.8. Compare the value with that of an ideal compressor, and comment on the performance of the compressor

9. Servicing & Maintenance of an automobile engine
9.1. Dismantle a two wheeler engine for servicing

9.2.   Assemble the engine in proper sequence
9.3.   Draw a preventive maintenance chart for a two wheeler engine

COURSE CONTENT
1) Study of valve timing diagrams of a four stroke Diesel & Petrol engines using a simulated model
2) Study of port timing diagrams of a two stroke Diesel&Petrol engines using a simulated model
3) Performance test on a single cylinder, water cooled diesel engine
4) Performance test on a single cylinder, air cooled, petrol engine
5) Heat balance test on a single cylinder, water cooled diesel engine
6) Economic speed test on a single cylinder, air cooled, petrol engine
7) Morse test on a multicylinder Petrol/Diesel engines
8) Volumetric efficiency of a single/two stage reciprocating air compressor
9) Dismantle and assembly of a two wheeler engine(The subject teacher is advised to organise a visit to any automobile service unit)

V Semester

Sub code	C16-Subjects	No of Periods per week		Total periods per semester	Scheme of Examination			
		Theory	Practice		Duration (Hrs)	Sessional Marks	End Exam Marks	Total Marks
THEORY								
M-501	Industrial Management & Smart Technologies	5		75	3	20	80	100
M-502	Industrial Engineering-Estimating and Costing	6		90	3	20	80	100
M-503	Refrigeration & Air-conditioning	5		75	3	20	80	100
M-504	Energy sources & Power Plant Engineering	5		75	3	20	80	100
M-505	Computer Aided Manufacturing systems	5		75	3	20	80	100
PRACTICAL								
M-506	Computer Aided Drafting & CNC lab		6	90	3	40	60	100
M-507	Non-Conventional Energy sources and R&AC lab		3	45	3	40	60	100
M-508	Life Skills		3	45	3	40	60	100
M-509	Workshop Practice - III		4	60	3	40	60	100
	T O T A L	26	16	630		260	640	900

Industrial Management & Smart Technologies

Subject Title	:	**Industrial Management & Smart Technologies**
Subject Code	:	**M-501**
Periods/Week	:	**5**
Period/Semester	:	**75**

TIME SCHEDULE

S. No.	Major Topics	Periods	Weightage Of Marks	Short Answer Questions	Essay Type Questions
1.	Basics of Industrial Management	06	13	1	1
2.	Organisation structure & Organisational behaviour	10	18	1	1$^{1/2}$
3.	Production Management	10	18	1	1$^{1/2}$
4.	Materials Management	08	13	1	1
5	Maintenance management & Industrial Safety	08	13	1	1
6	Entrepreneurship Development	08	13	1	1
7	Total Quality Management	05	06	2	
8	Smart technologies	20	16	2	1
	Total	**75**	**110**	**10**	**08**

1.   Basics of Industrial Management

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   Understand functions of Management.
       1.5   Explain the principles of scientific management.
       1.6   Explain the principles of management.
       1.7   Differentiate between management and administration.
       1.8   Understand the nature of management as a profession
       1.9   Differentiate between supervisory, middle and Top level management
       1.10   Explain the importance of managerial skills (Technical, Human, Conceptual)

2.   Organisation Structure & organisational behaviour

Know types of ownerships, the organisation structure of an industry and the behaviour of an

individual in an organisation.

       2.1   Understand the philosophy and need of organisation structure of an industry.
       2.2   Understand the line, staff and Functional organisations
       2.3   Understand the Authority and Responsibility Relationships
       2.4   Understand the differences between Delegation and decentralization
       2.5   Explain the factors of effective organisation.
       2.6   Outline the communication process
       2.7   State motivation theories.

2.8 State Maslow's Hierarchy of needs.
2.9 List out different leadership models.
2.10 Explain the trait theory of leadership.
2.11 Explain behavioural theory of Leadership.
2.12 Explain the process of decision making.
2.13 Assessing Human resource requirements
2.14 Know the concept of Job analysis, Job description and specifications
2.15 Understand the process of recruitment, selection, training and development
2.16 Understand types of business ownerships
2.17 Differentiate between the business ownerships
2.18 Know the objectives of Employee participation
2.19 Understand the meaning and definition social responsibilities
2.20 Corporate social responsibility

3. **Production management**

   Understand the different aspects of production management.

   3.1 Identify the factors of Plant Location
   3.2 Know the objectives of plant Layout
   3.3 Understand the principles of plant Layouts
   3.4 Explain the types of plant Layouts
   3.5 Relate the production department with other departments.
   3.6 State the need for planning and it's advantages.
   3.7 Explain the stages of Production, planning and control.
   3.8 Know the basic methods demand forecasting
   3.9 Explain routing methods.
   3.10 Explain scheduling methods.
   3.11 Explain dispatching.
   3.12 Explain Break Even Analysis
   3.13 Define supply chain Management, competitive strategy, Supply chain strategy
   3.14 Draw PERT/CPM networks.
   3.15 Identify the critical path

4. **Materials Management**

   *Understand the role of materials management industries**.*

   4.1 Explain the importance of materials management in Industry.
   4.2 Know Functions of Materials Management
   4.3 Derive expression for inventory control.
   4.4 Explain ABC analysis.
   4.5 Define safety stock.
   4.6 Define reorder level.
   4.7 Derive an expression for economic ordering quantity.
   4.8 Know the functions of Stores Management,
   4.9 Explain types of store layouts.
   4.10 List out stores records.
   4.11 Explain the Bin card.
   4.12 Describe Cardex method.
   4.13 Explain general purchasing procedures
   4.14 Explain tendering, E-tendering and E-procurement procedures
   4.15 List out purchase records.
   4.16 Know the applications of RFID (Radio Frequency Identification Device)
   4.17 Understand the applications of RFID in material management

5. **Maintenance Management & Industrial Safety**

   Comprehend the Importance of Maintenance Management & Safety procedures
   5.1   Explain the importance of maintenance management in Industry.
   5.2   Know the Objectives of maintenance management
   5.3   Know the activities of maintenance management
   5.4   Understand the importance of Preventive maintenance
   5.5   Understand the need for scheduled maintenance
   5.6   Differentiate between scheduled and preventive maintenance
   5.7   Know the principles of 5 s for good house keeping
   5.8   Explain the importance of safety at Work place.
   5.9   List out the important provisions related to safety.
   5.10   Explain hazard and accident.
   5.11   List out different hazards in the Industry.
   5.12   Explain the causes of accidents.
   5.13   Explain the direct and indirect cost of accidents.
   5.14   Understand the types of emission from process Industries, their effects on   environment and control
   5.15   Understand the principles of solid waste management

6. **Entrepreneurship Development.**

   Understand the role of entrepreneur in economic development and in improving the quality of life.

   6.1   Define the word entrepreneur.
   6.2   Explain the requirements of an entrepreneur.
   6.3   Determine the role of entrepreneurs in promoting Small Scale Industries.
   6.4   Describe the details of self-employment schemes.
   6.5   Characteristic of successful entrepreneurs
   6.6   Explain the method of site selection.
   6.7   List the financial assistance programmes.
   6.8   List out the organisations that help an entrepreneur
   6.9   Know the use of EDP Programmes
   6.10   Understand the concept of make in India, Zero defect and zero effect
   6.11   Understand the importance for startups
   6.12   Explain the conduct of demand surveys
   6.13   Explain the conduct of a market survey
   6.14   Evaluate Economic and Technical factors.
   6.15   Prepare feasibility report study

7. **Total Quality Management:**

   Understand the concepts adopted in total quality management

   7.1   Explain the concept of quality.
   7.2   List the quality systems and elements of quality systems.
   7.3   State the principles of quality Assurance.
   7.4   Understand the basic concepts of TQM
   7.5   Know the Pillars of TQM
   7.6   List the evolution of ISO standards.
   7.7   Explain ISO standards and ISO 9000 series of quality systems.
   7.8   List the beneficiaries of ISO 9000.

7.9 Explain the concepts of ISO 14000
7.10 Know the overview of PDCA cycle

8. Smart Technologies
8.1 Get an overview of IoT
8.1.1 Define the term IoT
8.1.2 Know how IoT work
8.1.3 List the key features of IoT
8.1.4 List the components of IoT : hardware, software, technology and protocols
8.1.5 List the advantages and disadvantages of IoT
8.2 IoT Applications
8.2.1 Smart Cities
8.2.2 Smart Energy and the Smart Grid
8.2.3 Smart Transportation and Mobility
8.2.4 Smart Home, Smart Buildings and Infrastructure
8.2.5 Smart Factory and Smart Manufacturing
8.2.6 Smart Health
8.2.7 Food and Water Tracking and Security
8.2.8 Social Networks and IoT

Course Content

1. Basics of Industrial Management
Introduction: Industry, Commerce and Business; Definition of management; Characteristics of management; Functions of management - Planning, Organizing, Staffing, Directing, Co-ordination, Controlling, Motivating, Communication, Decision Making; Principles of scientific management: – F.W.Taylor, Principles of Management: Henry Fayol; Administration and management; Nature of management; levels of management; managerial skills;

2. Organisation Structure & organisational behaviour
Organizing - Process of Organizing; Line/Staff and functional Organizations, Decentralization and Delegation, Effective Organizing; Communication, Motivational Theories; Leadership Models; Human resources development; Forms of Business ownerships: Types – Sole proprietorship, Partnership, Joint Stock Companies, Cooperative types of Organizations; Employee participation in management; Corporate Social responsibility;

3. Production management
Definition and importance; Plant location and layout; Types of production -job, batch and mass; production Planning and Control: Demand forecasting, routing, scheduling, dispatching and follow up; Break even analysis; Supply chain Management (Definition, Competitive strategy Vs Supply chain Strategy, Supply chain drivers); Project scheduling; Application of CPM and PERT techniques; simple numerical problems;

4. Materials Management
Materials in industry, Basic inventory control model, ABC Analysis, Safety stock, re-order level, Economic ordering quantity, Stores Management: Stores layout, stores equipment, Stores records, purchasing procedures, e-tendering, e-procurement; purchase records, Bin card, Cardex RFID (Radio Frequency Identification Device)application in materials management;

5. Maintenance Management & Industrial Safety
Objectives and importance of plant maintenance, Different types of maintenance, Nature of maintenance problems, Range of maintenance activities, Schedules of preventive maintenance, Advantages of preventive maintenance, 5 S principles; Importance of Safety at work places; Causes of accidents-psychological, physiological and other industrial hazards; Domino sequence;

methods of promoting safe practices; Pollution control in process industries; Introductory concepts on Solid waste management (General introduction including definitions of solid waste including municipal, hospital and industrial solid waste, Waste reduction at source – municipal and industrial wastes)

6. Entrepreneurship Development.

Definition of Entrepreneur; Role of Entrepreneur; Concept of Make In India, ZERO defect, Zero Effect, Concept of Start-up Company, Entrepreneurial Development: Role of SSI, MSME, DICs, Entrepreneurial development schemes; Institutional support, financial assistance programmes; Market survey and Demand survey; Preparation of Feasibility study reports

7. Total Quality Management:

Total Quality Management (TQM)- Concept of quality discussed by B. Crosby W. Edward, Deming, Joseph M. Juran, Kooru Ishikawa, Genichi Taguchi, Shigco Shingo. Quality systems – Definitions of the terms used in quality systems like, quality policy, quality management, quality systems, Stages of development of ISO 9000 series , ISO-14000, Deming's PDCA Cycle (Plan, Do, Check and Action). Japanese Quality Management, culture, Kaizen Strategy (continuous improvement).

8. Smart Technologies :

Overview of IoT - Define IoT, how IoT work, key features of IoT, components of IoT : hardware, software, technology and protocols, advantages and disadvantages of IoT - IoT Applications - Smart Cities, Smart Energy and the Smart Grid, Smart Transportation and Mobility, Smart Home, Smart Buildings and Infrastructure, Smart Factory and Smart Manufacturing, Smart Health, Food and Water Tracking and Security, Participatory Sensing, Social Networks and IoT.

REFERENCE BOOKS

1.   Industrial Engineering and Management -by O.P Khanna
2.   Production Management- by Buffa.
3.   Engineering Economics and Management Science - by Banga & Sharma.
4.   Personnel Management by Flippo.
5.   Production and Operations Management –S.N. Chary
6.   Converging_Technologies_for_Smart_Environments_and_Integrated_Ecosystems_IERC_Book_ Open_Access_2013 pages-54-76
7.   Supply Chain Management –Sunil Chopra and Meindl, PHI publishers
8   5 S made easy by David Visco

Industrial Engineering-Estimation and Costing

Subject Title : **Industrial Engineering-Estimation and Costing**
Subject Code : **M-502**
Periods/Week : **06**
Periods per Semester : **90**

TIME SCHEDULE

S.No	Major Topics	No. of Periods	Weightage of Marks	Short answer Questions	Essay Type Questions	Unit Test Syllabus
1	Introduction	02	03	1	--	Unit Test – I
2	Method Study	15	18	1	$1^{1/2}$	
3	Work Measurement	15	18	1	$1^{1/2}$	
4	Quality Control	15	16	2	1	
5	Fundamentals of Estimation and Costing	06	06	2		Unit Test - II
6	Estimation of weights and volumes of Material	14	18	1	$1^{1/2}$	
7	Estimation of Machining Times	08	13	1	1	
8	Estimation of cost in Welding, Forging and Foundry processes	15	18	1	$1^{1/2}$	
	Total	**90**	**110**	**10**	**08**	

OBJECTIVES:

1. Introduction
1.1   Appreciate scope of Industrial engineering.
1.2   Understands the work study as one of the means to improve productivity
1.3   State the objectives of work study.
1.4   State the techniques of work study

2. Method Study
2.1   Apply method study to a given situation.
2.2   State the steps involved in method study.
2.3   Identify the charts used in method study.
2.4   Assemble the elements with symbols to form the required chart.
2.5   State the question in their order to analyse the operational sequence.
2.6   Analyse the question to form the best sequence.
2.7   Conclude the best method of doing work
2.8   Identify the therbligs used in micro motion study
2.9   Know the procedure to build up   SIMO chart .

3. Work Measurement
3.1   State the purpose of work Measurement.
3.2   Describe the procedure of making Time study.
3.2   Explain the need for rating factor.
3.3   Compute normal time.
3.4   Explain the importance of Allowances.
3.5   Compute the standard time for an operation using observed time.
3.6   State the advantages of PMTS (Predetermined Motion Time Standards).
3.7   State the Procedure of PMTS

3.8   State the purpose of work sampling.
3.9   State the advantages of work sampling.
3.10   Describe the method of conducting work sampling.

4. Quality Control

4.1   Understand the concept of statistical Quality control
4.2   State the characteristics of normal distribution.
4.3   Construct control charts for variables and attributes.
4.4   Interpret control chart for "process in control" or "process out of control".
4.5   Select proper chart for a given situation.
4.6   State the principles of "Random Sampling''.
4.7   Differentiate Random sampling with 100% inspection
4.8   know the different types of sampling plans
4.9   Compute the probability of acceptance of a lot for a given single sampling plan.
4.10   Draw O.C. curve for single sampling plans.
4.11   Understand the various terms used in O.C. Curves.
4.12   Know the application of basic quality tools for continuous improvement
4.13   Know the importance and applications of Six Sigma
4.14   Understand the basic steps of SIX Sigma

5   Fundamentals of estimation and Costing

5.1   Define Estimation.
5.2   List the qualities of Estimator.
5.3   List the objectives and functions of estimation.
5.4   Explain the various constituents of estimation.
5.5   Explain the estimating procedure
5.6   Define Costing
5.7   List the objectives of costing
5.8   Explain the elements of costing
5.9   Explain the components of cost - prime cost, factory cost, office cost and total cost
5.10   Calculate the cost of a product taking into consideration all the items.
5.11   Calculate the selling price of a Product.
5.12   Define Depreciation
5.13   Explain the causes of depreciation
5.14   Compute depreciation by Straight line method, Sinking fund method, Reducing balance method, Sum of Years digits method.

6   Estimation of weights and Volumes of materials

6.1   Divide the component drawing into simple and smaller geometrical configurations.
6.2   Calculate the volumes and the weight of the material required.
6.3   Estimate the cost of material.
6.4   Solve simple problems on the above.

7   Estimation of Machining Times

7.1   Estimate time required for machining like turning, drilling, shaping, boring, screw cutting and grinding.
7.2   Use standard tables for feeds, cutting speeds.
7.3   Solve problems on the above.

8   Estimation of welding, forging and Foundry cost

8.1   Estimate the cost of Fabrication by Gas welding
8.2   Estimate the cost of Fabrication by Arc welding.
8.3   Estimate the cost of Gas cutting
8.4   Explain various forging losses
8.5   Estimate the length, net and gross weight and cost of forging for a given component.
8.6   Explain the allowances provided in foundry.

8.7   State the various costs involved in estimating foundry cost

8.8   Estimate foundry cost.

COURSE CONTENT

1. **Introduction:** Definition of industry and industrial engineering, scope and role of industrial engineering fields of applications. Productivity:Production and productivity; Work Study: Introduction, its relation with productivity aims, objectives and application of work study, basic procedure and techniques of work study.

2. **Method Study:** Definition objectives, basic procedures of methods study. Recording techniques, operation process chart, flow process chart, machine chart, flow diagrams, string diagrams, two hand process charts, questioning technique procedure to develop, install and maintain new methods. **Micro Motion Study:** Definition and objectives, techniques of micro motion study, Therbligs and their symbols, use of therbligs, SIMO chart and its application;

3. **Work Measurement:** Procedure of stop watch time study, General rules for breakdown of job into elements; performance rating, its meaning, standard rating, rating of operators, conditions for operators variation at work place rating scales, rating factors, calculation of basic time. Allowances- purpose, types. Determination of Standard time through Work Sampling, Predetermined motion time standard, standard data;

4. **Quality Control**: Introduction to Statistical Quality Control; Basic Quality tools for process improvement; Chance and Assignable causes of Quality variation, Advantages of shewhart control charts, Process Control charts for variables, X, R; Control Charts for attributes: P-Chart, nP Chart and 100p Chart. Product Control: Acceptance Sampling; 100% Inspection, operating characteristic curve (O.C. curve);Single, Double and Multiple sampling Plans, SS Plan; Producers Risk and Consumer's Risk, Indifference Quality level, Average Outgoing quality (AOQ) curve, AOQL; ABC Standard; Six sigma steps (Define-D, Measure-M, Analyze-A, Improve-I, Control-C);

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5. **Fundamentals of estimation and Costing:**Objectives and functions of estimation; Principal constituents of the estimation; estimation procedure: Labour, materials, overheads, miscellaneous expenses; Objectives of cost accounting – elements of cost viz., material, labour and expenses – Calculate the selling price of a product; Depreciation-causes-Calculation of depreciation charges by a few important methods (Straight line method, Sinking fund method, Reducing balance method, Sum of Years digits method)

6. **Estimation of weights and Volumes of materials** : Principles of dividing the component drawing into simple and smaller geometrical configurations; Calculation of volumes and the weight of the material; Estimating the cost ; Exercises in the calculation of weight of material and cost.

7. **Estimation of Machining Times:** Basic formula for the calculation of machining times for operations like, turning, drilling, shaping, boring, screw cutting and grinding,. Use of standard table of feeds, cutting speed etc; Exercises for the calculation of machining time for the above mentioned operations.

8. **Estimation of welding, forging and Foundry cost:** Estimate the cost of fabrication by gas welding and arc welding; Estimation of Forging Cost: Estimation of stock weight, net weight, gross weight, losses in forging; Exercises in the estimation of length, net and gross weight

and cost of forging for given components. Estimation of foundry cost: Process for finding the foundry cost, cost of metal, cost of metal melting, moulding, core cost, cleaning cost, grinding and tooling cost. Exercises in estimating the foundry cost.

REFERENCE BOOKS

Work study – by Ralph Banes.

Work study – by I.L.O.

Industrial Engineering & - Estimating &   Costing- byM.ZakriaBaig.

Industrial Engineering & - Management   Science – by T.R.Banga

S.Q.C – by Grant &Levenworth

S.Q.C –by Juran

S.Q.C –by Gupta

Industrial engineering and estimating and costing by M. Gopalaiah.

Industrial Engineering & Estimating&   Costing – byM.ZakriaBaig..

Industrial Engineering & Management   Science. – by T.R.Banga

Estimating & Costing   - by Agarwal.

Estimating & costing   -by Narang& Acharya

Estimating & Costing   -by T.R. Banga – Sharma.

Implementing six sigma   -Forrest Breyfogle, Smarter Solutions Inc

Refrigeration and Air conditioning

Subject title	:	**Refrigeration and Air conditioning**
Subject code	:	**M-503**
Periods per week	:	**05**
Periods per semester	:	**75**

TIME SCHEDULE

Sno.	Major Topics	No. Of Periods	Weightage	SAQ	EAQ	Unit Test bifur-cation
1	Fundamentals of Refrigeration & Air Refrigeration	10	13	01	01	Unit Test – I
2	Vapour compression Refrigeration Systems	10	16	02	01	
3	Vapour absorption Refrigeration Systems	08	13	01	01	
4	Refrigeration equipment	12	16	02	01	
5	Refrigerants & Refrigeration Applications	08	13	01	01	Unit Test – II
6	Fundamentals of Air conditioning & Equipment	12	16	02	01	
7	Psychrometry	07	10	-	01	
8	Applications of Air conditioning	08	13	01	01	
Total		**75**	**110**	**10**	**08**	

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

1. **Understand the various methods of Refrigeration**
1.1.   Define refrigeration
1.2.   Know the history of refrigeration.
1.3.   Know the different methods of refrigeration such as ice, dry ice, steam jet water refrigeration, liquid nitrogen refrigeration.
1.4.   Express unit of refrigeration in Terms of ton of refrigeration
1.5.   Define coefficient of Performance.
1.6.   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-Coleman air-cycle.
1.10.   Explain principle of closed air Refrigeration.
1.11.   Compare open air system with closed air system.

2. **Understand Vapour compression refrigeration system**
2.1.   Explain 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 between wet and dry compression.

2.4.   Know the effects of under cooling and super heating and effect of pressure changes on COP.
2.5.   State the use of flash chamber and accumulator
2.6.   Calculate COP of plant working on vapour compression system

3. **Understand vapour absorption refrigeration system:**
3.1.   Explain principle of simple vapour absorption systems.
3.2.   List refrigerant – Absorber pairs in the above system.
3.3.   State the desirable properties of refrigerants, absorbers.
3.4.   Illustrate the working principle of vapour absorption refrigeration system.
3.5.   Differentiate two fluid system and three fluid absorption system.
3.6.   Illustrate the working of Electrolux refrigeration

4. **Know the equipment used in refrigeration**
4.1.   Illustrate different types of compressors such as reciprocating and rotary types.
4.2.   State the function of condenser and classify the condensers,
4.3.   Explain different types of condensers such as Air cooled, Water cooled-shell & tube, shell and coil, Evaporative condensers with the help of a legible sketch.
4.4.   State the function of evaporator and classify the evaporators,
4.5.   Illustrate various types of evaporators
4.6.   Illustrate the various types of expansion devices
4.7.   Explain the refill type and throw away type dryers.

5. **Know the refrigerants and refrigeration applications**
5.1.   Distinguish between primary and secondary refrigerants.
5.2.   State the requirements of Refrigerants
5.3.   List the properties of refrigerants
5.4.   List commonly used refrigerants
5.5.   Illustrate the working of domestic refrigerator.
5.6.   Illustrate the working of ice Plant
5.7.   Illustrate the working of water cooler
5.8.   Illustrate the working of cold storage

6. **Understand fundamentals of Air conditioning and   air conditioning equipment**
6.1.   Define air conditioning
6.2.   List modern applications of Air conditioning.
6.3.   Explain Air conditioning as applied to human comfort
6.4.   Illustrate the functions of fans, ducts, filters , dust collector.
6.5.   Explain the use of heating and cooling coils
6.6.   Explain the air distribution system.

7. **Understand the science of Psychrometry**
7.1.   Define the terms humidity, Relative humidity, dew point, DBT & WBT, Absolute humidity, humidity ratio
7.2.   Explain the features of psychrometric chart
7.3.   Plot psychometric processes on the above chart
7.4.   Explain the psychrometric patterns for heating and cooling processes.

8. **Appreciate the applications of A/C**
8.1.   Illustrate the working of air coolers
8.2.   Illustrate the working of window air – conditioner
8.3.   Illustrate the working of cooling tower installations
8.4.   Illustrate the working of A/c systems viz., centralised and unitary systems
8.5.   Illustrate the working of summer-winter-year round air conditioners

COURSE CONTENT

REFRIGERATION

1. **Fundamentals of Refrigeration and Air Refrigeration:**
   1.1. **Introduction** – Definition and meaning of refrigeration,
   1.2. Methods of refrigeration
   1.3. Unit of refrigeration and COP
   1.4. Simple problems.
   1.5. Thermodynamic analysis of Refrigeration cycles- Carnot refrigeration cycle- Air refrigeration cycle (Bell – Colomen)(problems on air cycles omitted)
   1.6. Open air and closed air systems of refrigeration

2. **Vapour Compression Refrigeration Systems.**
   2.1. Working of VC system with p-h and T-s diagrams- Expression for COP (derivation omitted) –
   2.2. Factors effecting the COP viz. Sub cooling, superheating, pressure changes
   2.3. Functions of flash chamber and accumulator (sketches omitted)their location in VC circuit
   2.4. Simple problems on COP.

3. **Vapour absorption Refrigeration Systems**
   3.1. Layout of vapour absorption system – principle of working – expression (without proof) for C.O.P –
   3.2. List of popular refrigerants and absorbents – two fluid & three fluid systems
   3.3. Layout of Electrolux refrigerator – working principle
   3.4. Comparison of vapour absorption and vapour compression systems.

4. **Refrigeration Equipment :**
   4.1. Compressors – Classification and sub classification – working of Hermetic and semi hermetic type compressors with sketches – Rotary compressors – working of vane type and screw type compressors with sketches
   4.2. Condensers –Classification – layout of Air cooled, water cooled, Evaporative types – their working
   4.3. Evaporators – types of evaporators - working principle of shell and tube and dry evaporators with sketches – flooded type – working
   4.4. Expansion devices – types of expansion devices- working principle of capillary tube and thermostatic expansion devices with sketches
   4.5. Driers – types – working principle of refill type and throw away type driers.

5. **Refrigerants & Refrigeration Applications :**
   5.1. Primary and secondary refrigerants with examples – requirements of a refrigerant – properties of refrigerants – Commonly used refrigerants
   5.2. Applications of refrigeration – working principle (with line sketches) of
      5.2.1. Domestic refrigerator
      5.2.2. ice plant
      5.2.3. Water cooler
      5.2.4. Cold storage.

AIR CONDITIONING

6. **Fundamentals of A/c and A/c equipment**
   6.1. Definition of air conditioning – concept of Comfort air conditioning
   6.2. Factors affecting human comfort – comfort chart
   6.3. A/C Cycle equipment such as fans, supply ducts, outlets, return outlets and ducts
   6.4. Air distribution- Radial perimeter system, loop perimeter system, extended plenum system
   6.5. Filters & dust collectors –wet, dry, electric & viscous types, Cyclone air cleaner, air washer
   6.6. Heating and cooling coils

7. **Psychrometry**
   7.1. Psychrometry – Psychrometric terms – Practical applications of psychrometric terms
   7.2. Psychrometric processes
   7.3. Psychrometric chart – Simple direct problems applying psychrometric chart
   7.4. Psychrometric patterns for heating & cooling processes.

8. **Applications of Air conditioning**
   8.1. Working principle with layout for the following air conditioning appliances:
      8.1.1. Air coolers
      8.1.2. Window air conditioner – (split & package type) ,
      8.1.3. Cooling towers
      8.1.4. A/C systems for human comfort – summer/winter/year round air conditioning, central A/C system and unitary system

REFERENCE BOOKS
1. Refrigeration and Air Conditioning – by Domakundavar
2. Refrigeration and Air Conditioning – by Arora (MGH Publishers)
3. Basic Refrigeration and Air conditioning – by P N Ananthanarayana,(MGH Publishers)
4. Refrigeration and Air Conditioning – by Sarao & Gabi,
5. Refrigeration and Air Conditioning – by Dosatt
6. Refrigeration and Air Conditioning – by Stoecker

Energy Sources and Power Plant Engineering

Subject title	:	**Energy Sources and Power Plant Engineering**
Subject code	:	**M-504**
Periods per week	:	**05**
Periods per semester	:	**75**

TIME SCHEDULE

S.NO	Major Topics	No. of Periods	Weight age of Marks	SAQ	EAQ	Unit Test bifur-cation
1	Introduction to renewal sources of Energy	03	03	01	-	Unit Test – I
2	Solar Energy	16	26	02	02	
3	Wind energy	08	13	01	01	
4	Fuel Cells and MHD Generator	08	13	01	01	
5	Bio Energy	08	13	01	01	Unit Test – II
6	Tidal Energy	08	13	01	01	
7	Thermal power plants	12	16	02	01	
8	Nuclear power plants Environmental pollution	12	13	01	01	
	Total	**75**	**110**	**10**	**8**	

OBJECTIVES

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

1. Understand the need of energy sources

1.1. State various energy sources, give examples.
1.2. Classify energy sources as renewable and non renewable energy.
1.3. State advantages and disadvantages of renewable and non renewable energy sources.
1.4. Appreciate the need of renewable energy sources.
1.5. State the different types of renewable energy sources

2. Understand the concept of solar 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 pryheliometer,
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 legible sketch,
2.7. State the applications 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. Explain 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 the construction details and working principle of different types of solar water heater with the help of sketch

2.15. Explain the construction details and working principle of solar space heater with the help of sketch

2.16. Explain the construction details and working principle of absorption refrigerator type solar space cooler with the help of sketch

2.17. Explain the construction details and working principle of solar still with the help of sketch,

2.18. Explain connective type of solar drier.

2.19. Illustrate the working principle of Box type solar cooker,

2.20. State the principle of photo –voltaic conversion.

2.21. State the working principle of solar cell,

2.22. State the use of photo voltaic cell for power generation

2.23. Explain the solar photovoltaic arrays

2.24. Explain the solar water pumping system with a sketch,

2.25. State the advantages and limitations of solar energy conversion.

3. Understand the concept of wind energy

3.1. Explain the power available in the wind and force caused by it on the blades.

3.2. State the collection of wind data and estimate the energy,

3.3. State the different considerations for site selection for installing wind mill.,

3.4. Identify the basic components of a wind mill,

3.5. Illustrate the construction details and working principle of the wind mill,

3.6. State the differences between horizontal axis and vertical axis type wind mills,

3.7. Define the terms co-efficient of performance and tip speed ratio,

3.8. Plot curves to indicate the variation of co-efficient of performance with tip speed ratio.

3.9. Illustrate the method of generation of electricity by wind mill**,**

4. Comprehend Fuel Cells and MHD Generator

4.1. State the working principle of fuel cell

4.2. Illustrate the construction details and working principle of Bacan's High pressure fuel cell .

4.3. State the different types of fuels used in fuel cells

4.4. Explain the working principle of aluminium air fuel cell with a legible sketch,

4.5. Explain the working principle of MHD Generator a legible sketch**.**

5. Understand Bio- Energy

5.1. Understand the meaning of bio-mass and bio-gas.

5.2. State the principle of bio-gas generation,

5.3. State the chemical composition and properties of bio-gas,

5.4. List the applications of bio-gas,

5.5. List the different types of bio-gas plants,

5.6. Illustrate the construction details and working principle of fixed dome type and floating dome type bio-gas plants,

5.7. State the different materials used for bio-gas generation,

5.8. Express bio-gas plant capacity,

5.9. State the methods of generator control and load control,

6. **Understand Tidal energy**
6.1. Identify the energy available in tides and its usefulness in conversion,
6.2. State the working principle of tidal power plant,
6.3. State the different operation methods of utilisation of tidal energy,
6.4. Explain single basin and double basin arrangements,
6.5. State the site requirements for installation of tidal power plant.
6.6. State the advantages and limitations of tidal power generation

7. **Analyse the elements of Thermal power plant**
7.1. Illustrate the layout of a thermal power plant.
7.2. Locate the Boiler, super heater, turbine, Electric Generator, Condenser and hot well pump in the layout
7.3. Explain function of circulating water pump, Economiser, Air pre heater, Soot– Blower.
7.4. Explain the dust extraction in Electrostatic precipitator
7.5. Explain about the ash removal, water cooling
7.6. Explain about the feed water treatment.
7.7. Explain about the coal handling, coal storage
7.8. Identify the fuel handling equipment.
7.9. Trace the ash disposal system
7.10. State the necessity of condensing the steam
7.11. State the principle of condensation in condenser,
7.12. List different types of condensers,

8. **Analyse the elements of Nuclear power plant**
8.1. Understand the chain reaction,
8.2. Understand the process of nuclear fission and nuclear fusion.
8.3. List nuclear fuels- nuclear materials with examples,
8.4. State the characteristics of atomic power plants,
8.5. Illustrate the principle of working of a nuclear reactor,
8.6. Classify the nuclear reactors ,
8.7. Illustrate the working principle and constructional details of Nuclear power plants
8.8. Explain the effects of nuclear radiation,
8.9. Explain the disposal of nuclear waste (i)   Ground   (ii) Air   (iii) Ocean

COURSE CONTENT
1. **Introduction:**
1.1. Various energy sources – examples for energy sources – relative advantages and disadvantages
1.2. Need for alternate sources of energy – types of non conventional energy sources – basic principles of solar energy, wind energy, energy from bio- mass and bio-gas, tidal and wave energy, Geothermal energy, hydrogen energy, fuel cells**,**

2. **Solar Energy:**
2.1. **Solar Radiation**: Solar constant – solar radiation at earth's surface – instruments for measuring solar radiation – pyranometer, pryheliometer.
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**

    2.4.1. Solar water heater – natural circulation type and forced circulation type

    2.4.2. Solar space heater – passive type and active type

    2.4.3. Solar space cooling – absorptive refrigeration system

    2.4.4. Solar still

    2.4.5. Solar drier – cabinet type and convective type

    2.4.6. Solar cooker

2.5. **Photo voltaic conversion :**solar cell – working principle – cell – photo voltaic cell for power generation, solar photo voltaic arrays

2.6. solar water pumping system

2.7. Advantages and disadvantages of solar energy.

3. Wind Energy

3.1. Introduction – power in the wind forces on the blades – wind data – energy estimation – site selection considerations

3.2. Basic components of a wind mill – construction details and working principles of – horizontal axis type: multi blade, propeller type, Dutch type

3.3. Vertical axis type: Savonius type, Darrius type- variation of co efficient of performance with tip speed ratio

3.4. Electric generation by wind mill – generator control – load control.

4. Fuel Cells and MHD Generator

4.1.   Working principle – types of fuels used – advantages and limitations

4.2.   Bacon's High pressure fuel cell – construction details and working principle

4.3.   Air fuel cell working principle

4.4.   Working principle of MHD Generator

5. Bio Energy

5.1.   Bio Energy – Introduction to bio – mass. Bio-mass conversion into energy. Bio-gas generation – composition and properties of bio-gas – applications of bio-gas.

5.2.   Classification of bio-gas plants – continuous and batch type, the dome and drum type, floating gas holder and fixed dome type

5.3.   construction details and working principle of fixed dome type and floating gas holder type bio – gas plants –

5.4.   Materials used for bio-gas generation – capacity of bio-gas plant – starting of bio-gas plant- method of control of generator and load

6. Tidal Energy

6.1.   Introduction to tidal power – components of tidal power plants

6.2.   Operation methods and utilisation of tidal energy

6.3.   Single basin and double basin arrangements- site requirements and installation

6.4.   Advantages and limitations of tidal power generation**.**

7. **Thermal Power Plants**
7.1.   Layout of a Thermal Power Plant, Choice of site, functions of important elements in layouts: Such as Boiler, Condenser, super heater, turbine, Economiser, Air heater, Soot–Blower , Forced draught Fan, Dust collectors, Electro static precipitator
7.2.   Feed water system, Circulating water pumps,
7.3.   Supporting activities- Such as Water cooling, Feed water treatment, Coal handling, Coal storage, Chimney.
7.4.   Description of fuel handling equipment, unloading equipment, preparing equipment,
7.5.   Modern ash handling equipment, dust collection and disposal , roots blower.
7.6.   Condensers- principles classification – comparison – condensers and vacuum efficiencies

8. **Nuclear Power Plants**:
8.1.   Nuclear energy ,chain reaction , list of nuclear materials, reactor, nuclear fission , nuclear fusion characteristics of automatic power plants, nuclear fuels ,
8.2.   Working principle of nuclear reactor, classification of reactors
8.3.   Working principle of Pressurised water reactor (PWR), Boiling water reactor(BWR)
8.4.   Gas Cooled reactor(GCR), liquid metal – cooled reactor,
8.5.   Fast breeder reactor
8.6.   Effects of nuclear radiation Nuclear waste disposal.

REFERENCE BOOKS
1.   Non conventional Energy source by G.D Rai
2.   Energy Technology by S. Rao & Dr. D.B. Palek (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
7   Thermal Engineering by   Arora & S. Domkundwar

Computer Aided Manufacturing Systems

Subject Title	:	Computer Aided Manufacturing Systems
Subject Code	:	M-505
Periods per week	:	05
Period per semester	:	75

TIME SCHEDULE

SI No.	Major Topics	No. Of periods	Weightage	SAQ	EAQ	Unit Test Syllabus
1.	Introduction to Computer aided manufacturing	8	13	1	1	Unit Test – I
2.	Introduction to Numerical Control	8	13	1	1	
3.	CNC and DNC systems	8	13	1	1	
4.	Basic principles of CNC hardware	14	16	2	1	
5	CNC programming	16	16	2	1	Unit Test – II
6	Material handling systems of CAM	8	13	1	1	
7	Flexible manufacturing systems	8	13	1	1	
8	Computer Integrated Manufacturing Systems	5	13	1	1	
	TOTAL	**75**	**110**	**10**	**08**	

OBJECTIVES

1. Introduction to Computer aided manufacturing (CAM)
1.1. Appreciate the necessity of computer monitoring and control of manufacturing process
1.2. Define various computer aided manufacturing support functions viz.CAD, CADD, CAE, CAPP, CATD etc.,
1.3. List out the benefits of computer aided manufacture (CAM)
1.4. Illustrate the product cycle of a traditional manufacturing system
1.5. Illustrate the product cycle of a CAM system
1.6. Illustrate an integrated CAD/CAM system
1.7. Explain graphically the various types of production
1.8. State the concept of group technology
1.9. State the advantages and limitations of group technology

2. Introduction to Numerical Control
2.1. Define numerical control (NC)
2.2. List out the advantages and limitations of NC manufacturing system in comparison to tradition manufacturing system
2.3. State the applications of NC systems
2.4. Illustrate an NC machine tool and explain the functions of its principal elements
2.5. Explain with a block diagram the manufacturing methodology of an NC system
2.6. Explain with illustrations the PTP, 1-axis, 2-axis, 3-axis numerical control modes

3. CNC and DNC systems

3.1. Define Computer Numerical control (CNC)
3.2. Illustrate a CNC machine tool and explain the functions of its principal elements
3.3. State the principal differences between NC and CNC systems
3.4. State the advantages of CNC systems over NC systems
3.5. Define direct numerical control (DNC)
3.6. Illustrate a DNC system
3.7. State the features of a DNC system
3.8. List out the advantages and applications of DNC
3.9. Compare NC, CNC and DNC systems
3.10. Illustrate a CNC-CMM
3.11. State the features of CNC-CMM
3.12. Explain the working of CNC-CMM

4. Basic principles of CNC hardware

4.1. State the requirements of machine bed and spindle in a CNC machine tool
4.2. State the basic design principles of CNC machine tool bed and spindle
4.3. State the requirements of spindle and feed drives of CNC machine tools
4.4. Explain the various types of spindle and feed drives used in CNC machine tools
4.5. State the requirements of actuation systems in CNC machine tools
4.6. Explain with illustration the working of a lead screw with recirculating balls and nut
4.7. State the requirements of the guide ways in CNC machine tool
4.8. Explain with illustration the working of antifriction guide ways
4.9. Explain with illustration the working of a linear ball bush
4.10. Illustrate the open and closed loop control systems
4.11. Explain with illustrations the principle of absolute encoders (natural binary& gray)
4.12. Explain with illustrations the principle of incremental encoders
4.13. State the requirements of cutting tool materials in CNC system
4.14. Name the cutting tool materials used in CNC
4.15. State the applications of cemented carbide, coated carbides and ceramic tool materials
4.16. State the requirements of tool manipulations in CNC machine tools
4.17. Explain with illustration the working of a tool magazine (drum type & Chain type)
4.18. Explain with illustrations the working of a automatic tool changer (ATC)
4.19. State the requirements of work holding devices in CNC machine tools
4.20. Explain with illustrations work holding devices – Grid plate, Tomb stone and angle plate

5. CNC Programming

5.1. Explain with a block diagram the various steps involved in developing a part program
5.2. Define manual part programming
5.3. Illustrate a block of a CNC program code in word address format as per ISO
5.4. Explain the syntax of each word in a word address format as per ISO
5.5. Differentiate between Geometry (G) and Miscellaneous (M) codes
5.6. Explain with syntax some of the popular G & M codes
5.7. Write a CNC program for a simple turning job in G & M codes
5.8. State the necessity of tool length and nose radius compensation in CNC programming
5.9. Illustrate the coding of tool length compensation in a CNC program
5.10. Define Computer aided part programming (CAP)
5.11. State the advantages of CAP over manual programming
5.12. Appreciate APT as a popular CAP language
5.13. Illustrate with a block diagram the configuration of CAP with APT
5.14. Explain the syntax of popular Geometry statements of APT language
5.15. Explain the syntax of popular Motion statements of APT language

5.16.   Explain the syntax of popular post processor statements of APT language
5.17.   Explain the syntax of popular compiler statements of APT language
5.18.   Write a program in APT language for a simple drilling job from a given drawing
5.19.   Name the commercially available GUI based CAP programming languages and state their advantages over APT

6.   Material handling systems in CAM
6.1.   State the requirements of material handling systems in CAM
6.2.   Differentiate between Primary and Secondary material handling systems
6.3.   Define an automated guided vehicle (AGV)
6.4.   Explain the various types of AGV with illustrations
6.5.   State the applications of various AGV
6.6.   Define a Robot
6.7.   State the necessity of Robots in manufacturing environment
6.8.   Explain various types of Robots with illustrations
6.9.   Illustrate an industrial Robot showing its principal elements
6.10.   Explain the functions of the Principal components of a Robot

7.   Flexible manufacturing systems (FMS)
7.1.   State the necessity of FMS
7.2.   Explain the meanings of Machine flexibility, Production flexibility, Mix flexibility, Product flexibility, Routing flexibility, Volume flexibility, Expansion flexibility
7.3.   Illustrate the layout of a typical FMS showing the principal components
7.4.   Explain the functions the principal components of an FMS
7.5.   State the features, advantages and applications of FMS

8.   Computer Integrated Manufacturing Systems (CIMS)
8.1.   Illustrate design functions module, manufacturing functions module and Business functions module of a manufacturing system
8.2.   State the necessity of integrating the various modules of a manufacturing system
8.3.   Define CIMS
8.4.   Illustrate CIMS showing the principal components
8.5.   State the benefits of CIM
8.6.   Appreciate the concept of lean manufacturing
8.7.   List out the steps involved in lean manufacturing
8.8.   State the benefits of lean manufacturing

COURSE CONTENT

1.   Introduction to Computer aided manufacturing (CAM)
1.1.   Role of computers in manufacturing–Computer aided monitoring and control –computer aided manufacturing support functions viz. CAD, CADD,CAE, CAPP,CATD – Benefits of CAM
1.2.   Product cycle in traditional and computerized manufacturing environments – linkage of various manufacturing functions through computerized database– Integrated CAD/CAM
1.3.   Types of production systems –Transfer line production – Flexible manufacturing system – Standalone CNC system – features and applications of each type
1.4.   Group Technology – advantages and limitations

2.   Introduction to Numerical Control
2.1.   Brief overview of historical development of Numerical control technology – advantages over conventional manufacturing system – Limitations – applications
2.2.   Working principle of NC machine tool- elements of NC machine tool

2.3.   Manufacturing methodology of NC systems – Part drawing – Part program – Program tape – Tape reader – Controller – Machine tool

2.4.   Numerical control modes – Point to point control – One axis control – Simultaneous two axes control – Simultaneous three axes control

3.   CNC and DNC systems

3.1.   Working principle of CNC machine tool – Principal differences over NC systems – advantages over NC system

3.2.   Direct Numerical control – concept – features – advantages –applications

3.3.   Comparative treatment of NC, CNC, and DNC systems

3.4.   CNC Co-ordinates measuring machine (CNC-CMM) – Principle of working – Principal components – features – advantages – applications

4.   Basic principles offence hardware

4.1.   Principles of CNC machine tool bed and Spindle design – Spindle drives and Feed drives – DC servo motors – AC servo motors – Stepper motors – Linear motors

4.2.   Actuation systems – lead screw with recirculating balls and nut –Antifriction guide ways – Linear ball bush

4.3.   Feedback devices – Closed loop CNC control system – Absolute encoders (natural binary & gray) – Incremental encoders

4.4.   Materials for cutting tools used in CNC – Cemented carbides – Coated carbides – Ceramics

4.5.   Tool holding devices – Drum type and chain type Tool magazines

4.6.   Working of automatic tool changer (ATC)

4.7.   Work holding devices – Grid plate –Tomb stone

5.   CNC programming

5.1.   Steps involved in development of part program – Process planning –Axes nomenclature for CNC turning and machining centres – Tool selection – Cutting process parameters selection – Job and tool setup planning – Machine tool path planning – Part program writing – Part program verification

5.2.   Manual part programming (as per ISO) – Word address format –meaning of each word – List of preparatory functions – List of miscellaneous functions

5.3.   Tool length compensation – Nose radius compensation – Cutter radius compensation

5.4.   Computer aided part programming (CAP) – advantages over manual part programming

5.5.   List of Geometry, Motion, Post processor and Compiler commands used in APT

5.6.   Sample programs for simple turning jobs in G & M codes

5.7.   Sample programs in APT for simple Drilling jobs

5.8.   Overview of commercially available GUI based CAP programming languages – advantages over APT language

6.   Material handling systems in CAM

6.1.   Material handling systems – functions in CAM environment – Primary and secondary systems – automated guided vehicle systems (AGVS)

6.2.   AGV types – Towing vehicles – Unit load vehicles – Pallet trucks – Fork trucks – Light load vehicles – Assembly line vehicles – their applications

6.3.   Robots – areas of application – types of robots

6.4.   Layout of an industrial robot – functions of each component

7.   Flexible manufacturing systems (FMS)

7.1.   Different types of flexibilities – Machine flexibility – Production flexibility – Mix flexibility – Product flexibility – Routing flexibility – Volume flexibility – Expansion flexibility

7.2.   Layout of a typical FMS showing principal components

7.3.   Components of FMS – CNC machine centres –material handling equipment – Computer control – Human functions

7.4.   Features of FMS – advantages – applications

8. Computer Integrated Manufacturing Systems (CIMS)
8.1. Components of a manufacturing system – Design functions module – Manufacturing functions module – Business functions module – Necessity of Integration
8.2. Concept of CIM– Benefits of CIM
8.3. Lean manufacturing – Introduction – steps involved – Benefits of lean manufacturing

REFERENCE BOOKS

1	Numerical Control and Computer Aided Manufacturing	T.K.Kundra,P.N.Rao	TMH
2	Computer Aided Manufacturing	T. K. Kundra, P.N. Rao	MGH Publishers
3	CAD/CAM	Groover and Zimmers	Pearson Education India
4	Lean tools and 5 S	Joe Bronski and fancesco lannelo	Kindle Edition

Computer Aided Drafting & CNC Laboratory

Subject Title : **Computer Aided Drafting & CNC Laboratory**
Subject Code : **M 506**
Periods per week : **06**
Period per semester : **90**

TIME SCHEDULE

SI No.	Major Topics	No. of periods
1.	Auto CAD toolbars & menus	09
2.	Dimensioning & Hatching	03
3.	2D drawings	12
4.	3D solids and solids tool bars	06
5.	Drawing of 3D components – Bolt & Nut, Screw jack	12
6.	Rendering 3D images	03
7	Study of CNC machine	06
8	Incremental and Absolute system	03
9	G-Codes and M-codes	06
10	Simulation software practice	06
11	Turning exercise – step turning	03
	Turning exercise – circular interpolation	06
	Turning exercise – Taper turning using canned cycle	03
	Turning exercise – Peck drilling using canned cycle	03
	Turning exercise – Thread cutting using canned cycle	06
	Turning exercise – grooving using canned cycle	03
	Total	**90**

Note: This lab should be treated as a single subject. The course work is compulsory in all the exercises. The end examination consists of one question from any of the above exercises

OBJECTIVES

Up on completion of the course the student shall be able to
1. Auto CAD screen and various Tool bars and menus
2. Explain about Dimensioning and Hatching
3. Draw the 2D – drawings like **knuckle joint, screw jack, flange coupling, lathe tool post, eccentric** etc.,
4. Explain about 3D solids and solids tool bar options
5. Drawing of 3D – components like **bolt&nut, screw jack**
6. Rendering of 3D images
7. Study of CNC machine
8. Incremental system and absolute system on dimensioning.

9. G-codes and M-codes and part program writing
10. Simulation software practice
11. Turning exercises like step turning, taper turning, peck drilling, thread cutting, grooving with/without canned cycles using available CNC machine

COURSE CONTENTS

1) Study the Auto CAD screen, various toolbars and menus
   a) Exercises on usage of Draw and modify tool bar.
   b) Exercises on mirror, rotate, array and move commands
2) Exercises on dimension and hatching
3)
   a) Draw the knuckle joint full details & dimensioning
   b) Draw the screw jack 2D drawing
4) Study the 3D solids (primitives) and solids tool bar options
5)
   a) Draw bolt and nut in 3D
   b) Draw various parts of screw jack in assemble them as 3D component
6) Render the 3D images already generated and apply materials and light.
7) Study of CNC machine installed in the laboratory, identify the parts and know the function of parts
8) Useincrementalsystemandabsolutesystemondimensioning.
9) Familiarization with G-codes and M-codes and part program writing
10) Simulation software practice using available softwares
11)
   a) Turning exercise step turning
   b) Turning exercise using circular interpolation (CW/CCW)
   c) Turning exercise taper turning
   d) Turning exercise peck drilling
   e) Turning exercise thread cutting
   f) Turning exercise grooving with/without canned cycles using available CNC machine

Note: The CAD softwares available are AUTOCAD, ProgeCAD etc.
The simulation softwares available in the market:
FANUC, SIEMENS, HI NUMERIC, GSK etc.,

Non conventional Energy sources and R&AC lab

Subject Title : **Non conventional Energy sources and R&AC lab**
Subject Code : **M – 507**
Periods per Week : **03**
Periods per Semester : **45**

TIME SCHEDULE

S.No		Number of Periods
1	C O P of Vapour Compression cycle test rig	03
2	C O P of domestic refrigerator test rig	03
3	C O P of water cooler test rig	03
4	C.O.P. of A.C. system	03
5	Vacuumisation and Charging of refrigeration system	03
6	Servicing & Maintenance of R & AC Equipment	06
7	Study and performance of Pyranometer	03
8	Study of solar appliances	06
9	Study of wind mills	06
10	Study and performance test on photovoltaic cell	03
11	Study of wind speed measuring instruments	03
12	Study of Bio gas plants-KVIC, Janatha, Deenabandhu plants	03
Total		**45**

Note: This lab should be treated as a single subject. The course work is compulsory in all the exercises. The end examination consists of one question from any of the above exercises

OBJECTIVES
   Up on completion of the course the student shall be able to

1. C.O.P of Vapour Compression cycle test rig
    1.1. State the scope of performance test on VCR test rig
    1.2. Identify the various components of test rig
    1.3. Draw the experimental lay out and basic cycle
    1.4. State the tool and equipment required
    1.5. State the observations to be made
    1.6. Understand the P-H diagram for given refrigerant
    1.7. Calculate the COP of test rig

2. C.O.P of Domestic refrigerator
    2.1. Identify the various components
    2.2. Draw the experimental layout

2.3. State the observations to be made
2.4. Understand the P-H diagram for given refrigerant
2.5. Calculate the COP of test rig

3. C.O.P of Water cooler test rig
   3.1. Identify the various components
   3.2. Draw the experimental layout
   3.3. State the observations to be made
   3.4. Understand the P-H diagram for given refrigerant
   3.5. Calculate the COP of test rig

4. COP of Air Conditioning system
   4.1. Identify the various components
   4.2. Draw the experimental layout
   4.3. Understand the process humidification and dehumidification
   4.4. State the observations to be made
   4.5. Understand the P-H diagram for given refrigerant
   4.6. Calculate the COP of test rig

5. Vacuumization and Charging of refrigeration system
   5.1. Know the reason for removal of air from refrigeration system
   5.2. Evacuate the given system using vacuum pump
   5.3. Apply leak tests before charging
   5.4. State the need of correct amount of refrigerant for effective performance
   5.5. Understand the procedure of charging
   5.6. Check the quantity of fluid charged(By weight difference)

6. Servicing & Maintenance of R & AC Equipment
   6.1. Prepare the maintenance schedule for domestic refrigeration system
   6.2. Apply leak detection methods for refrigerant leaks
   6.3. Familiarise the symptoms of faults in refrigerant system and their remedies.

7. Understand the working of solar radiation-\

8. Study of the following solar appliance
   8.1. Solar heaters
   8.2. Solar still

9. Study of the following wind mills
   9.1. Horizontal axis wind mill
   9.2. Vertical axis wind mill

10. Study wind measuring instruments

11. Study and performance of commonly used Bio gas plants

Course contents
1. Determination of COP of Vapour Compression cycle test rig.
2. Determination of COP of domestic refrigerator test rig.
3. Determination of COP of water cooler test rig.
4. Conduct a performance test on given air-conditioning system and evaluate C.O.P. of the system.
5. Vacuumization & Charging, pressure testing of given refrigeration system.
6. Servicing and maintenance of R&AC equipment--trouble shooting and leak detection of
    6.1. Domestic refrigerator
    6.2. Window/split air conditioner
7. Study and performance of Pyranometer
8. Study of solar appliances- Heaters- Stills
9. Study of wind mills-
10. Study of wind speed measuring instruments
11. Study of Bio gas plants-KVIC, Janatha, Deenabandhu plants

Life Skills

Subject Title   :   **Life Skills**
Subject Code   :   **M-508**
Periods/ Week   :   **03**
Periods/Semester   :   **45**

TIME SCHEDULE

Sl No.	UNITS	No. of periods Allotted		
		Explanation	Activities	Total
1.	ATTITUDE	1	3	4
2.	ADAPTABILITY	1	3	4
3.	GOAL SETTING	1	3	4
4.	MOTIVATION	1	3	4
5.	TIME MANAGEMENT	1	3	4
6.	CRITICAL THINKING	2	3	5
7.	CREATIVITY	1	3	4
8.	PROBLEM SOLVING	1	3	4
9.	TEAM WORK	1	3	4
10.	LEADERSHIP	1	3	4
11.	STRESS MANAGEMENT	1	3	4
	TOTAL	12	33	45

Note: No Written Examination; The total 45 hours are to be considered as Theory hours.
Marks: Internal – 40;   External – 60

OBJECTIVES:
Upon the completion of this course, the student shall be able to
1.0   Understand the concept of Attitude
    1.1   Define 'Attitude'
    1.2   Explain the importance of Attitude
    1.3   Distinguish between Positive and Negative Attitudes
    1.4   Life Response: Need for change of Attitude
     1.5   Positive Attitude: Key to success in Personal and Professional Lives

2.0   Understand the concept of Adaptability
    2.1   Define the term 'Adaptability'
    2.2   Explain the concept of Adaptability
    2.3   Advantages of Adaptability
    2.4   Disadvantages of Lack of Adaptability
    2.5   Need for positive response to change

3.0 Understand the concept of Goal setting
  3.1 Define the terms'Goal' and 'Goal Setting'
  3.2 Explain the significance of Goal setting&Long and Short term goals
  3.3 Explain the following concepts
         a) Wish   b) Dream c) Goal
  3.4 Explain the reasons for and consequences of not setting goals
  3.5 The SMART features in Goal setting

4.0 Understand the concept of Motivation
  4.1 Define 'Motivation' ; Inspiration Vs Motivation
  4.2 Importance of motivation in Goal setting
  4.3 Distinguish between Internal (Self) Motivation and External Motivation
  4.4 De-motivating Factors and how to overcome them
  4.5 Motivating oneself and others

5.0 Understand Time Management skills
  5.1 Define 'Time Management'.
  5.2 Comprehend the significance of Time Management.
  5.3 Explain the Time Quadrant
  5.4 Common Time wasters and how to overcome them.
  5.5 How to meet deadlines and targets within time

6.0 Understand Critical Thinking
  6.1 Define"Critical Thinking",
  6.2 Understand the importance of Critical Thinking
  6.3 Distinguish between facts and opinions (assumptions)
  6.4 Inculcating different perspectives
  6.5 Developing Reasoning abilities and form sound judgments

7.0 Understand Creativity
  7.1 Understand the importance of and need for creative ideas
  7.2 Distinguish between Linear Thinking and Lateral Thinking
  7.3 Distinctive qualities of creative people
  7.4 Unusual or creative use of familiar objects
  7.5 Creative ways of solving problems

8.0 Understand Problem Solving
  8.1. Define the concept of Problem solving
  8.2 Viewing the problems as challenges
  8.3 Different steps in solving a problem
  8.4 Selecting the best solution to solve a problem
  8.5 Lateral thinking in Problem solving

9.0 Understand Team Work
  9.1 Define Team work
  9.2 Develop Team skills
  9.3 Advantages of team work
  9.4 Understand responsibilities as a team player
  9.5 Problems of working in a team and possible solutions

10.0   Understand Leadership
       10.1   Define Leadership
       10.2   Identify Leadership qualities
       10.3   Analyze one's strengths and limitations as a leader
       10.4   Types of Leadership: Autocratic and Democratic
       10.5   Leadership by example

11.0   Understand Stress Management
       11.1   Define Stress
       11.2   Explain the causes of stress
       11.3   Learn Stress Management skills
       11.4   Need for positive thinking and self esteem
       11.5   Practice Stress Management strategies

Workshop Practice-III

Subject Title   :   **Workshop Practice-III**
Subject Code   :   **M-509**
Periods/Week   :   **04**
Periods per Semester   :   **60**

S. No.	Name of Experiment	No of periods allotted
1	**Milling**	
	1.1 T-slot cutting on milling machine.	6
	1.2 Spur gear cutting on milling machine	6
	1.3 Helical gear cutting on milling machine	6
2	**Slotting**	
	2.1 Key way cutting by slotting machine	6
	2.2 Indexing method in slotting machine	6
3	**Planning**	
	3.1 preparation of plain surface with planning machine	6
4	**Grinding**	
	4.1 preparation of rectangular block of precise dimensions by using surface grinding machine	6
	4.2 Sharpening of lathe tools by tool and cutter grinder	3
	4.3 sharpening of milling cutter by tool and cutter grinder	3
	4.4 Sharpening of drill bit by using tool and cutter grinder	3
5	**Metrology**	
	5.1 Linear Measurement by Slip gauges	3
	5.2 Angular Measurement by Sine Bar	3
	5.3 Gear Tooth Measurement using Gear Tooth Caliper	3

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

1) Milling

    a) Get hands on experience on Milling of Spur, Helical gears and T-slots

2) Slotting

    a) Get hands on experience on Key way cutting on slotting with indexing attachment

3) Planning

    a) Get hands on experience on Planningof flat surfaces using a planer

4) Grinding

    a) Get hands on experience on surface grinder

b) Get hands on experience on Tool and cutter grinder

5) Metrology

a) Get hands on experience on use of slip gauges

b) Get hands on experience on use of Sinebar

c) Get hands on experience on use of Gear tooth vernier

COURSE CONTENTS

1) **Milling**
   a) T-slot cutting on milling machine.
   b) Spur gear
   c) Helical gear cutting on milling machine

2) **Slotting**
   a) Key way cutting by slotting machine.
   b) Indexing method in slotting machine

3) **Planning**
   a) preparation ofplain surfacewith planning machine

4) **Grinding**
   a) Preparation of rectangular block of precise dimensions by using surface grinding machine.
   b) Sharpening of lathe tools, milling cutter and drill bit by using tool and cutter grinder.

5) **Metrology**
   a) Linear measurement by slip gauges
   b) Angular measurement by Sine bar
   c) Gear Tooth Measurement using Gear Tooth Calliper

C-16-VI SEMESTER
M-601 INDUSTRIAL TRAINING

Scheme of evaluation:

S.No	Subject	Duration	Items	Max Marks	Remarks
1	M-601 Practical Training in the Industry	6 Months	1.First Assessment (at the end of 3rd month)	100	
			2. Second Assessment (at the end of 6th month)	100	
			3.Training report i) Log Book	30	
			ii) Report	30	
			4. Seminar	40	
		Total :		**300**	

The industrial training shall carry 300 marks and pass marks are 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% attendence.

M-601 INDUSTRIAL TRAINING

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

VI 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 completes 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 training report (Record) 30 marks,

    For maintenance of log book 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 Section.
(2) External Examiner preferably from Industry
(3) Staff member who assessed the student during the Industrial Training.

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	05
2.	Familiarity with Technical terms	06
3.	Familiarity with tools and material	10
4.	Attitude towards job	07
5.	Manual skills	04
6.	Application of knowledge	10
7.	Problem solving skills	10
8.	Comprehension and observation	04
9.	Safety and Environmental consciousness	03
10.	Human relations	04
11.	Ability to communicate	06
12.	Supervising ability	10
13.	General conduct during the period	06
14.	Maintenance of dairy	15
	Total	**100**