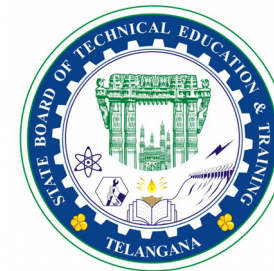

CURRICULUM – 2014

(C-14)

**DIPLOMA IN
MECHANICAL ENGINEERING**

1



**State Board of Technical Education & Training
Telangana State
HYDERABAD**

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CURRICULUM (C-14) FOR DIPLOMA COURSES IN Telangana

I. PREAMBLE

The State Board of Technical Education and Training, **Telangana** under the aegis of the Department of Technical Education, Telangana generally reviews the Curricula once in every five years. However, recognizing the changing needs as stated by the user industries, the Board has decided to bring forward the revision of curriculum. Consequently, the Board with the assistance of NITTTR, Chennai under the guidance of Prof. C. Nagendra Rao, performed the evaluation of C-09 Curriculum in force. On finding the merits and demerits of C-09 Curriculum the faculty have made a thorough assessment of the curricular changes that have to be brought in. It was felt that there is an urgent need to improve hands-on experience among the students pursuing diploma courses. Further, the urgency of enhancing communication skills in English was also highlighted in the feedback and suggestions made by the user industries. Keeping these in view, a number of meetings and deliberations were held at district and state level, with experts from industry, academia and senior faculty of the department. The new Curricula for the different diploma courses have been designed with the active participation of the members of the faculty teaching in the Polytechnics of Telangana, 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 – 2014 or C-14 is vetted by NITTTR, Chennai followed by BoG approval of SBTET for its implementation with effect from 2014-15.

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. 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.

4. 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 in IV and V semesters respectively for all the branches except Chemical Engineering and Chemical Engineering (Sugar Technology) for which life skills is introduced at 3rd semester level.
5. In addition to Engineering Mathematics in I year (Mathematics -102) and III semester (Mathematics-301), Mathematics-401 has been introduced in the IV semester of present syllabus.
6. 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.
7. CAD specific to the branch has been given more emphasis in the curriculum. Preparing drawings using CAD software has been given more importance.
8. 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.
9. The number of teaching hours allotted to a particular topic/chapter has been rationalized keeping in view the past experience
10. Upon reviewing the existing C-09 curriculum, it is found that the theory content is found to have more weightage than the Practical content. In the revised C-14 curriculum, more emphasis is given to the practical content of Laboratories and Workshops, thus strengthening the practical skills.
11. 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. While the course content in certain subjects is reduced, in rest of the subjects the content has been enhanced as per the need.
12. A new subject "**Field Practices**" is introduced in 5th Semester. In Field Practices, the students will perform all the industry oriented activities for all types of Field tastings and make use of the machinery, equipment and tools actually used in the industry. By this, the student will get first-

hand experience of performing various practical procedures and field experiments to enhance their skills.

13. All Practical subjects are independent of each other and the practice of grouping two or more practical subjects is dispensed with.
14. Curriculae 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 Ajay Jain, I.A.S., Commissioner of Technical Education & Chairman, S.B.T.E.T. and Smt.Sailaja Ramaiyer, I.A.S., 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 the Sri. D. Venkateswarlu, Secretary, SBTET, Telangana and Dr. CN Rao, Professor and Head, NITTTR, ECH and other officials of Directorate of Technical Education and the State Board of Technical Education, Telangana, experts from industry, academia from the universities and higher learning institutions and all teaching fraternity from the Polytechnics who are directly and indirectly involved in preparation of the curricula.

II. RULES AND REGULATIONS

1. ADMISSION PROCEDURES :

1.1 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 Electronics with specialization in CP/ CN/ IE/ TV/ BM/ Embedded systems, the training will be in the seventh semester.

1.2 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.

- i) 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, Telangana, Hyderabad.

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

- a) The candidates seeking admission should have appeared for the X class examination, conducted by the Board of Secondary Examination, Telangana or equivalent examination thereto, at the time of making application to the Common Entrance Test for Polytechnics for admissions into Polytechnics (POLYCET). In case of candidates who apply pending results of their qualifying examinations, their selection shall be subject to production of proof of their passing the qualifying examination in one attempt or compartmentally at the time of interview for admission.
- b) Admissions are made based on the merit obtained in the Common Entrance Test (POLYCET) and the reservation rules stipulated by the Government of Telangana from time to time.
- c) 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

1.3 MEDIUM OF INSTRUCTION

The medium of instruction and examination shall be English.

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

1.5 NUMBER OF WORKING DAYS PER SEMESTER / YEAR:

- a). The Academic year for all the Courses usually shall be from Fifteenth June of the year of admission to the 31st March of the succeeding year.
- b). The Working days in a week shall be from Monday to Saturday
- c). There shall be 7 periods of 50 minutes duration on all working days.
- d). The minimum number of working days for each semester / year shall be 90 / 180 days excluding examination days. If this prescribed minimum is not achieved due to any reason, special arrangements shall be made to conduct classes to cover the syllabus.

1.6 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). Candidates having less than 65% attendance shall be detained.
- d). Students whose shortage of attendance is not condoned in any semester / 1st year are not eligible to take their end examination of that class and their admissions shall stand cancelled. They may seek re-admission for that semester / 1st year when offered next.
- e). A stipulated fee shall be payable towards condonation for shortage of attendance.

1.7 READMISSION

Readmission shall be granted to eligible candidates by the respective RJD / Principal.

- 1) Within 15 days after commencement of class work in any semester (Except industrial Training).
- 2) Within 30 days after commencement of class work in any year (including D. Pharmacy course or first year course in Engineering and Non Engineering Diploma streams).

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

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

2. SCHEME OF EXAMINATION**2.1 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 and VI Semesters:

THEORY EXAMINATION: Each subject carries usually 80 marks and 40 marks in respect of specified subjects of 3hours duration, along with 20/10 marks for internal evaluation (sessional marks) respectively.

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

2.2 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) Practicals: Student's performance in Laboratories / Workshop shall be assessed during the year of study for 40% marks in each practical subject. Allotment of marks should be discrete taking into consideration 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 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 the department preferably choosing a person from an Industry. 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 marks 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 institute level will be done by a minimum of three members Internal Faculty, Industrial Experts and H.O.D. and be averaged.

- h) In case of Diploma courses **not having Industrial Training** in the curriculum, the students shall make **Industrial visits** as per the schedule given below:

S.No	Semester	Nature of Training/Exposure	Duration
1	III Semester	Industrial Visits	5 no. (One week)
2	IV Semester	Industrial Visits	5 no. (One week)
3	End of Semester Vacation of IV Semester	Industrial Training	4 Weeks
4	V Semester	Industrial Visits	5 no. (one Week)
		Simulated Industrial Training (Field Practices)	3 Weeks
5	VI Semester	Industrial Visits	5 no. (one Week)
Total			11 Weeks

NOTE: No Marks shall be awarded for the above industrial visits. However, it will be evaluated as satisfactory/unsatisfactory.

2.3 MINIMUM PASS MARKS

THEORY EXAMINATION:

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

PRACTICAL EXAMINATION:

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

2.4 PROVISION FOR IMPROVEMENT

- Improvement is allowed only after he / she has completed all the subjects from First Year to Final semester of the Diploma.
- Improvement is allowed in any 4 (Four) subjects of the Diploma.
- The student can avail of this improvement chance only once, that too within the succeeding two examinations after the completion of Diploma, with the condition that the duration including Improvement examination shall not exceed FIVE years from the first admission.

- No improvement is allowed in Practical / Lab subjects or Project work or Industrial Training assessment. However, improvement is allowed in drawing subject.
- If improvement is not achieved, the marks obtained in previous Examinations hold good.
- Improvement is not allowed in respect of the candidates who are punished under Mal-practice in any Examination.
- Examination fee for improvement shall be paid as per the notification issued by State Board of Technical Education and Training from time to time.
- 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.

3 RULES OF PROMOTION TO NEXT LEVEL :

3.1 For Diploma Courses (Except HMCT, Architecture, Chemical-Sugar & Auto mobile Engineering) From 1ST YEAR TO 3rd, 4th, 5th, 6th and 7th Semesters:

- A candidate shall be permitted to appear for first year examination provided he / she puts in 75% attendance and pays the examination fee. However, he/she can be condoned on Medical grounds upto 10% (i.e. attendance after condonation on Medical grounds should not be less than 65%) and he/she has to pay the condonation fee along with examination fee.
- 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.
- A candidate shall be promoted to 4th semester provided he/she puts the required percentage of attendance in the 3rd semester and pays 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
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 on fulfilment of 3(i)(ii) clauses stated above. 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 have obtained eligibility to appear for 4th Semester examination.

For IVC students.

- i) Puts the required percentage of attendance in the 5th semester
 - ii) Should have appeared for 4th Semester examination.
 - iii) Should not have failed in more than Four backlog subjects of III Semester
5. A candidate shall be promoted to 6th semester provided he/she has puts 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 examination if he/she

- i) Puts the required percentage of attendance in 6th semester and
- ii) Should not have failed in more than six backlogs subjects of 1st year, 3rd & 4th semesters put together.

For IVC students.

- i) Puts the required percentage of attendance in the 6th semester
- ii) Should have obtained eligibility to appear for V semester examination.
- iii) Should not have failed in more than Six backlog subjects of III & IV Semester put together.

3.2 For HMCT, Architecture and Chemical - Sugar courses

- 1) The same rules are applicable on par with other diploma courses with the exception that the Industrial Training is in the 5th semester.
- 2) A candidate shall be promoted to 5th semester (Industrial Training) provided he/she puts the required percentage of attendance in the 4th semester and pay the examination fee. A candidate, who could not pay the 4th semester examination fee, has to pay the promotion fee as prescribed by the SBTET from time to time before commencement of 5th semester (Industrial Training).
- 3) A candidate shall be promoted to 6th semester of the course provided he/she has successfully completed the Industrial Training (Passed).
A candidate is eligible to appear for the 6th semester examination if he/she
 - (i) Puts the required percentage of attendance in 6th semester.
 - (ii) Should not have failed in more than six backlog subjects of 1st Year, 3rd & 4th semesters put together.

For IVC students

- i) Puts the required percentage of attendance in the 6th semester
- ii) Should have completed the Industrial Training.
- iii) Should not have failed in more than Six backlog subjects of III & IV Semester put together.

3.3 For Automobile Engineering Course

The same rules are applicable on par with other diploma courses with the exception that the Industrial Training is in the 6th semester. A Candidate shall be promoted to 6th semester provided he/she puts the required percentage of attendance in 5th semester and pay the examination fee. A candidate, who could not pay the 5th semester examination fee, has to pay the promotion fee prescribed by SBTET from time to time before commencement of 6th semester (Industrial Training).

Or

The Automobile Engineering Industrial Training may be shifted to 5th semester on par with **HMCT/ARCH/CH (ST)**

3.4 For Diploma Courses of 3 ½ Years duration:

3.4.1 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.
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.
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 would be 90 % attendance and attends for the VIVA-VOCE examination at the end of training.
6. A candidate shall be promoted to 7th semester of the course provided he/she has successfully completed both the spells of Industrial Training (Passed).
A candidate is eligible to appear for 7th semester examination if he/she
 - i) Puts the required percentage of attendance in the 7th semester and
 - ii) Should not have failed in more than 6 backlog subjects of 1st year, 3rd and 4th semesters put together.

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- iii) Should not have failed in more than six backlog subjects of 3rd and 4th semester put together for IVC students.

3.4.2 For Diploma Courses of 3 ½ Years duration:

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- i) In respect of Diploma in Footwear Technology, the Industrial training is offered in two spells, the 1st spell of Industrial training after the First Year (i.e. III semester of the course) and the second spell of industrial training after the V semester (i.e VI Semester of the course). The promotion rules for this course are on par with the other sandwich Diploma courses except that there is no restriction on number of backlog subjects to get eligibility to appear for the 4th semester examination and ,
A candidate is eligible to appear for 5th semester examination if he/she
 1. Puts the required percentage of attendance in the 5th semester and
 2. Should not have failed in more than four subjects of 1st year.
- ii) A candidate shall be promoted to 7th semester of the course provided he/she has successfully completed second spell of Industrial Training (Passed).
A candidate is eligible to appear for 7th semester examination if he/she
 1. Puts the required percentage of attendance in the 7th semester and
 2. Should not have failed in more than 6 backlog subjects of 1st year and 4th semesters put together.
 3. Should not have failed in more than six backlog subjects of 4th and 5th semester
put together for IVC students.

3.4.3 For Diploma Courses of 3 ½ Years duration:

BM

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

OR

Run through system for 1st Year and 3rd semester to 6/7th semester provided that the student puts in 75% of attendance (which can be condoned on medical grounds upto 10%) i.e. attendance after condonation on medical grounds should not be less than 65%.

3.5 OTHER DETAILS

- In case a candidate does not successfully complete the Industrial training, he / she will have to repeat the training at his / her own cost.
- The I spell of Industrial training shall commence 10 days after the completion of the last theory examination of 4th Semester.
- The Second spell of Industrial training shall commence within 10 days after the completion of I spell of Industrial training.
- Each Semester of Institutional study shall be a minimum of 90 working days. (With 6 working days in a week i.e. from Monday to Saturday, with 7 periods of 50 minutes, duration per day.

4 STUDENTS PERFORMANCE EVALUATION

4.1 AWARD OF DIPLOMA

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

- First Class with Distinction shall be awarded to the candidates who secure an overall aggregate of 75% marks and above.
- First Class shall be awarded to candidates who secure overall aggregate of 60% marks and above and below 75% marks.
- 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.

With respect to the intermediate vocational 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 alone be taken into consideration for

determining the overall percentage of marks secured by the candidates for award of class/division.

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

4.2 EXAMINATION FEE SCHEDULE:

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

4.3 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 hour's duration.

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

Section B contains 8 essay type questions including Numerical questions, out of which 5 questions each carrying 10 marks are to be answered.

Max.Marks: 5 x 10 = 50.

Total Maximum Marks: 80.

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

Practical Examinations

For Workshop practice and Laboratory Examinations,

Each student has to pick up a question paper distributed by Lottery System.

Max. Marks for an experiment / exercise : 50%

Max. Marks for VIVA-VOCE : 10%

Total : 60%

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

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

4.4 ISSUE OF MEMORANDUM OF MARKS

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

4.5 MAXIMUM PERIOD FOR COMPLETION OF DIPLOMA COURSES:

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

4.6 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.

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

- 4.7.1 a) A candidate desirous of applying for Recounting/ issue of Photo copy of valued answer scripts/ Reverification should submit the application to the Secretary, State Board of Technical Education and Training, Telangana., Hyderabad – 500 063 within 15 days from the date

of receipt of Tabulated Marks Statement by the Principal of concerned Polytechnic or the date specified.

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

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

1. Marks secured as per Tabulated Marks Sheet certified by the Principal.
2. Demand draft towards the payment of fee
3. Self – addressed and stamped envelopes of 11" X 5" size.

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

4.7.2 FOR ISSUE OF PHOTO COPIES OF VALUED ANSWER SCRIPTS

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

4.7.3 FOR RE-VERIFICATION OF THE VALUED ANSWER SCRIPT

1. A candidate desirous of applying for Re-verification of valued answer script should submit the application to the Secretary, State Board of Technical Education and Training, Telangana., Hyderabad – 500 063 along with the required fee in the form of Demand Draft, within 15 days from declaration of result.
2. Re-verification of valued answer script shall be done for all theory subjects including drawing subjects.
3. The following documents should invariably be enclosed with the application failing which the application will not be considered.
 - (i) Marks secured as per Tabulated Marks Sheets certified by the Principal.
 - (ii) Fee in the form of Demand Draft.

4.7.4 MALPRACTICE CASES:

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

4.7.5 DISCREPANCIES/ PLEAS:

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

5 ISSUE OF CERTIFICATES AND VETO

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

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

5.2 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.

5.3 GENERAL

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

**DIPLOMA IN MECHANICAL ENGINEERING
SCHEME OF INSTRUCTIONS AND EXAMINATIONS**

V Semester

Subject Code	Name of the Subject	Instruction period / week		Total Period / year	Scheme of Examination			
		Theory	Practical/ Tutorial		Duration (hours)	Sessional Marks	End Exam Marks	Total Marks
THEORY:								
M-501	Industrial Management	4	-	60	3	20	80	100
M-502	Design of Machine Elements -II	4	-	60	3	20	80	100
M-503	Estimating & Costing	4	-	60	3	20	80	100
M-504	Heat Power Engineering-II	4	-	60	3	20	80	100
M-505	Fluid Power Control Systems	4	-	60	3	20	80	100
M-506	Machine Tool Engineering	4	-	60	3	20	80	100
PRACTICAL:								
M-507	CAD Lab Practice	-	6	90	3	40	60	100
M-508	Life skills	-	3	45	3	40	60	100
M-509	Hydraulics & Pneumatics Lab Practice	-	3	45	3	40	60	100
M-510	Field practices	-	6	90	3	40	60	100
TOTAL		24	18	630		280	720	1000

Note: 1. Five number of local industrial visits / Interaction, one from each of the courses listed from M 502 to 506 may be arranged to enable the students to have industry exposure.

2. Duration: Total of all the visits not exceeding one week

- The students need to submit 2-3 page write up mentioning all salient learning experiences like advance in technology, its evaluation, application, advantages & disadvantages, expected changes in future etc..

3. Three weeks simulated industrial training (Field practices) may be arranged to enable the students to have hands on practice.

- The students need to prepare a model/working drawing/Job drawing/machine component and submit 2-3 page write up mentioning all salient learning experiences.

4. Industries: Exposure on reading and interpretation of work / job drawings / Hydraulic and pneumatic training centre.

INDUSTRIAL MANAGEMENT

Subject Title : Industrial Management

Subject Code : ME -501

Periods/Week : 04

Periods per Semester : 60

TIME SCHEDULE

S. No.	Major Topics	Periods	Weightage Of Marks	Short Answer Questions	Essay Type Questions
1.	Principles and functions of Management	10	21	02	1½
2.	Organisation structure & organisational behaviour	20	34	03	2 ½
3	Production Management	14	26	02	02
4.	Materials Management	16	29	03	02
	Total	60	110	10	08

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OBJECTIVES

Upon completion of the course the student shall be able to

1.0 Understand the principles of management as applied to industry

1.1 Define industry, commerce (Trade) and business.

1.2 Explain the scope and need for management.

1.3 Understand the evolution of management

1.4 Explain the principles of scientific management.

1.5 Understand functions of Management.

1.6 Differentiate between management and administration.

2.0 Understand types of ownerships, the organisation structure of an industry and the behaviour of an individual in an organisation

2.1 Explain types of ownerships

2.2 Differentiate types of ownerships.

2.3 Explain salient features of joint stock companies.

2.4 Need of organisation structure of an industry.

- 2.5 Explain the line, staff and functional organisations along with legible sketches.
- 2.6 List the advantages and limitations of line, staff and functional organisations.
- 2.7 List different departments in a large scale industry.
- 2.8 Explain the factors of effective organisation.
- 2.9 Explain organisational behaviour.
- 2.10 Explain job analysis.
- 2.11 Assess the incurring applicants.
- 2.12 Outline the selection process.
- 2.13 List the sources of manpower.
- 2.14 State motivation theories.
- 2.15 State Maslow's Hierarchy of needs.
- 2.16 Explain the phenomena of satisfaction.
- 2.17 Explain the performance levels.
- 2.18 Explain reward system
- 2.19 List different leadership models.
- 2.20 Explain the trait theory of leadership.
- 2.21 Explain behavioural theory of Leadership.
- 2.22 Explain the process of decision Making.
- 2.23 Explain the communication process.
- 2.24 Analyse the behaviour of groups in an organisation.
- 2.25 Explain group dynamics.
- 2.26 Detail the process of managing conflict.
- 2.27 Explain conflict resolution strategies.
- 3.0 Understand the different aspects of production management**
- 3.1 Differentiate and integrate production, planning and control.
- 3.2 Relate the production department with other departments.
- 3.3 State the need for planning and its advantages.
- 3.4 Explain the stages of production, planning and control.
- 3.5 Explain routing methods.
- 3.6 Explain scheduling methods.
- 3.7 Explain dispatching.
- 3.8 Draw PERT/CPM networks.

- 3.9 Identify the critical path.
- 4.0 Understand the role of materials management industries**
- 4.1 Explain the role of the materials in Industry.
- 4.2 Derive expression for inventory control.
- 4.3 Explain ABC analysis.
- 4.4 Define safety stock.
- 4.5 Define reorder level.
- 4.6 Write the expression for economic ordering quantity and mention the terms involved in the expression.
- 4.7 Explain stock layout.
- 4.8 List stores records.
- 4.9 Explain the Bin card.
- 4.10 Describe Cardex method.
- 4.11 Explain purchasing procedures.
- 4.12 List purchase records.
- 4.13 List the stores equipment
- 4.14 Explain the need of material handling methods.
- 4.15 Explain material handling methods. List out hoists, cranes, conveyers, trucks, and forklift trucks.
- 4.16 Explain break-even analysis.

COURSE CONTENT

1. Principles and functions of management

Definitions of Industry, Commerce and Business. Evolution of management theories. Principles of Scientific Management, functions of management. Difference of administration and management.

2. Organisation Structure & organisational behaviour

Role of industry, Types of ownership - Sole proprietorship, Partnership, Private limited, Public limited company, Industrial Cooperatives, Philosophy, types of Organisations, Line and Staff and functional organisations. Advantages and limitations, departments in a large scale industry. Effective organisation. Job analysis, Assessing applicants, selection, motivation, different theories, satisfaction, performance reward systems, Leadership in organisation, decision making, communication, group dynamics, Managing conflict.

3. Production Management

Production, planning and control, relation with other departments, need for planning and its advantages, Routing, scheduling, despatching, PERT and CPM, simple problems.

4. Materials Management

Materials in industry, inventory control model, ABC Analysis, Safety stock, re-order, level, Economic ordering quantity, Break even analysis, Stores layout, stores equipment, Stores records, purchasing procedures, purchase records, Bin card, Cardex, Material handling, Manual lifting, Hoist, Cranes, conveyors, trucks, fork trucks.

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.

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DESIGN OF MACHINE ELEMENTS-II

Subject Title	:	Design of Machine Elements-II
Subject Code	:	M-502
Periods/Week	:	04
Periods/Semester	:	60

TIME SCHEDULE

S. No	Major Topics	Periods	Weightage of Marks	Short Answer Questions	Essay Type Questions
1.	Belts and chain drives	12	21	02	1 ½
2.	Gear drives	12	21	02	1 ½
3.	Fly wheels and Governors	10	21	02	1 ½
4.	Brakes and Clutches	10	26	02	02
5.	Cams	10	21	02	1 ½
6.	Use of Design hand book	06	-	-	-
Total		60	110	10	08

OBJECTIVES

Upon completion of the course the student shall be able to

- 1. Understand the Design of Belts and chain drives**
 - 1.1 List the different power drives
 - 1.2 Compare the flexible drives with the rigid drives
 - 1.3 Classify the belt drives
 - 1.4 List the belt materials
 - 1.5 Define the slip and creep in belts.
 - 1.6 Explain the effect of slip and creep on power transmission
 - 1.7 State the expression for the length of open and cross belts
 - 1.8 State the expression for ratio of limiting belt tensions
 - 1.9 State the expression for centrifugal tension in the belt
 - 1.10 Explain the effect of centrifugal tension on power transmission
 - 1.11 Design the belt cross-sectional dimensions (V-belts are excluded)

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- 1.12 Design the cone pulley for open and cross belts
- 1.13 Solve the numerical problems related to the above cases
- 1.14 List the different elements of chain drive
- 1.15 Classify the chain drives
- 1.16 Differentiate between belt and chain drives
(Problems and derivations are excluded for chain drives)
- 2. Understand the Design of Gear drives**
- 2.1 Explain the nomenclature of spur gear tooth.
- 2.2 State the law of gearing (Derivation is excluded)
- 2.3 Identify various tooth profiles of gear.
- 2.4 Explain the terminology related to gear drive
- 2.5 List the gear material
- 2.6 List all the advantages and disadvantages of gear drives
- 2.7 Classify the gear drives based on different criteria
- 2.8 Write the Lewis bending equation
- 2.9 Design the gear based on Lewis equation
- 2.10 List different types of gear trains
- 2.11 Design different types of gear trains for given velocity ratios
- 2.12 Explain the applications of gear trains
- 2.13 Solve the problems related to simple, compound and reverted gear trains
- 3. Understand the Design of Fly wheels and Governors**
- 3.1 State the function of flywheel
- 3.2 List the applications of flywheel
- 3.3 Explain the terms related to flywheel
- 3.4 Derive the expression for maximum fluctuation the formula for energy stored by flywheel
- 3.5 Design the rim type flywheel for the max fluctuation of energy
- 3.6 Solve simple problems on fly wheel
- 3.7 Explain the function of governor using legible sketch
- 3.8 Classify the governors
- 3.9 Distinguish between Governor and Flywheel
- 3.8 Describe the working principle of Watt governor and Porter governor using legible sketch
- 3.9 Write the expressions for the height of watt and Porter governor

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- 3.10 List the applications of governor
- 3.11 Explain the terms - sensitiveness, stability, isochronism, hunting, effort and power of governor
- 3.12 Solve simple problems on governors
- 4. Understand the Design of Brakes and Clutches**
- 4.1 State the function of brake
- 4.2 Classify the brakes
- 4.3 List all the brake material
- 4.4 Explain the working of shoe brake with the help of legible sketch
- 4.5 Explain the working of band brake with the help of legible sketch
- 4.6 Derive an expression for the braking torque
- 4.7 Solve simple problems related to brakes
- 4.8 Explain the Function of clutch
- 4.9 Classify the clutches
- 4.10 List all the clutch materials
- 4.11 Explain the working of single and multiple plate clutches
- 4.12 Design single plate and multi-plate clutches based on uniform pressure and uniform wear
- 4.13 Solve simple problems related to clutches
- 5. Understand the Design of Cams**
- 5.1 Explain the function of cam
- 5.2 Explain the features of cam profile.
- 5.3 Classify the cams.
- 5.3 Define terms related to cam profile.
- 5.4 Draw angular - displacement diagram for lift motion for:
a)Uniform velocity.
b)S.H.M.
c)Uniform acceleration & retardation.
- 5.5 Draw simple cam profiles in above three cases for knife edged, flat and roller followers. (Offset followers are omitted)

COURSE CONTENT

1. 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 - (problems on chain drives omitted)

2. Gear drives

Gear tooth terminology, Law of gearing - involute and cycloidal profiles, Gear material, Design of spur gear based on Lewis equation - 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 - thread cutting on a lathe - back gear assembly of a lathe-Selection of gear wheels to cut threads for a given pitch on a lathe-Problems on screw cutting on lathe - Back gear assembly - 3- Speed gear box of an automobile, Calculation of velocity ratio-Description and application of epi-cyclic gear trains (Problems on epi-cyclic gear trains not included)

3. 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-Design of rim type flywheel knowing the fluctuation of energy - Formula for energy stored by fly wheel (without proof) - simple problems - Governor - function - Classification - Explanation of Simple Watt governor and Porter governor - Difference between Flywheel and Governor - Sensitiveness, Stability, Isochronism, Hunting, Effort and Power of governor - Simple problems on watt governor and porter governor.

4. Brakes and clutches

Function of brakes - Classification of brakes-Brake materials - Working of simple shoe brake and band brakes only - Simple problems on shoe brake and band brakes only - Function of clutch - Classification of clutches-Clutch material - Working of single plate and multi-plate clutches, Difference between Brake and clutch - Simple problems on single plate and multi-plate clutches based on uniform pressure and uniform wear

5. Cams

Function of cam - 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 edged, flat & roller follower for all three types of motions stated above - Problems on drawing of cam profiles as stated above for the follower axis passes through the axis of the cam shaft (offset followers not included)

REFERENCE BOOKS

1. Machine Design - R.S.Khurmi.
2. Design of Machine Elements - Pandya and Shah.
3. Theory of machines- Thomas Bevan.
4. Design of Machine Elements - V B Bhandari [Tata Mc Graw Hill]

ESTIMATING AND COSTING

Subject Title	:	Estimating and Costing
Subject Code	:	M-503
Periods/Week	:	04
Periods per Semester	:	60

TIME SCHEDULE

S. No.	Major Topics	No. of Periods	Weightage of Marks	Short Answer Questions	Essay Type Questions
1.	Elements of costing	12	21	02	1 ½
2.	Fundamentals of estimation	06	08	01	½
3	Estimation of weights of materials and Machining times	16	39	03	03
4.	Estimation of fabrication cost	08	13	01	01
5.	Estimation of forging cost	10	16	02	01
6.	Estimation of foundry cost	08	13	01	01
Total		60	110	10	08

OBJECTIVES

Upon completion of the course the student shall be able to

1.0 Understand the elements of costing

- 1.1 Define Costing
- 1.2 List the objectives of costing
- 1.3 Explain the elements of costing
- 1.4 Define Depreciation
- 1.5 Explain the causes of depreciation
- 1.6 Compute depreciation by different methods.
- 1.7 Explain the components of cost - prime cost, factory cost, office cost and total cost
- 1.8 Calculate the cost of a product taking into consideration all the items.

- 1.9 Calculate the selling price of a Product.

2.0 Understand the fundamentals of estimation

- 2.1 Define Estimation.
- 2.2 List the qualities of Estimator.
- 2.3 List the objectives and functions of estimation.
- 2.4 Explain the various constituents of estimation.
- 2.5 Explain the estimating procedure.

3.0 Estimate the weight of material required for a product and machining times

- 3.1 Divide the component drawing into simple and smaller geometrical configurations.
- 3.2 Calculate the volumes and the weight of the material required.
- 3.3 Estimate the cost of material.
- 3.4 Solve simple problems on the above.
- 3.5 Estimate time required for machining like turning, drilling, shaping, boring, screw cutting and grinding.
- 3.6 Use standard tables for feeds, cutting speeds.
- 3.7 Solve problems on the above.

4.0 Estimate the fabrication cost

- 4.1 Define the Meaning of Fabrication
- 4.2 List the types of fabrication.
- 4.3 Estimate the cost of Fabrication by Gas welding - using table
- 4.4 Estimate the cost of Fabrication by Arc welding .
- 4.5 Estimate the cost of Gas cutting - using table

Note: Use Gas welding & Gas cutting table for obtaining consumption of gas, filler rods, rate of welding, speed of cutting.

5.0 Estimate forging cost

- 5.1 Define Forging.
- 5.2 List the types of forging
- 5.3 Explain various forging losses.
- 5.4 Estimate the length, net and gross weight and cost of forging for a given component.

6.0 Estimate foundry cost

- 6.1 List steps for making castings in foundry.

- 6.2 Explain the allowances provided in foundry.
 6.3 State the various costs involved in estimating foundry cost
 6.4 Estimate foundry cost.

COURSE CONTENT

1.0 Elements of costing

Explanation of term costing - objectives of cost accounting - elements of cost viz., material, labour and expenses - Depreciation-causes- : Calculation of depreciation charges by a few important methods.

Determine the items that go into prime cost. On cost, calculate the cost of a product taking into consideration all items. Calculate the selling price of a product.

2.0 Fundamentals of estimating

Explanation of the term, objectives and function of estimating - principal constituents of the estimating of the cost of component - design time, drafting, planning and production time, design and procurement or manufacture of special tools and equipment, estimate work, labour, materials, overheads, miscellaneous expenses - estimating procedure.

3.0 Estimation of weights of materials and machining time

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. 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.

4.0 Estimation of fabrication cost

Explain the term fabrication - types, estimate the cost of fabrication by gas welding and arc welding - estimate the cost of gas cutting - exercises for the calculation of fabrication cost.

5.0 Estimation of forging cost

Components of forging cost, estimation of stock weight, net weight, gross weight, losses in forging, estimation of stock size.

Exercise in the estimation of length, net and gross weight and cost of forging for given components.

6.0 Estimation of foundry cost

Process for finding the foundry cost, cost of metal, cost of metal melting,

moulding cost, core cost, cleaning cost, grinding and tooling cost. Methods of estimating the above. Exercises in estimating the foundry cost.

REFERENCE BOOKS

1. Mechanical Estimating & Costing - by B.P.Sinha
2. Industrial Engineering & Management Science. - by T.R.Banga
3. Estimating & Costing - by Agarwal.
4. Estimating & costing - by Narang & charya.
5. Estimating & Costing - by T.R. Banga - Sharma.

HEAT POWER ENGINEERING - II

Subject Title	:	Heat Power Engineering - II
Subject Code	:	M-504
Periods/Week	:	04
Periods per Semester	:	60

TIME SCHEDULE

S. No.	Major Topics	Periods	Weightage of Marks	Short Answer Questions	Essay type Questions
1	Properties of Steam	10	20	02	01
2	Steam Boilers	15	32	02	02
3	Steam Nozzles	10	18	02	1 ½
4	Steam Turbines	15	20	02	02
5	Steam Condensers	10	20	02	1 ½
	Total	60	110	10	08

OBJECTIVES

Upon completion of the course the student shall be able to

1.0 Understand the Properties of Steam

- 1.1 Define the various properties of steam
- 1.2 Compute the enthalpy, internal energy and entropy at given pressure.
- 1.3 Use of the steam tables
- 1.4 Interpret the data in steam tables to calculate enthalpy and entropy.
- 1.5 Compute the above values using Mollier chart.
- 1.6 Solve simple problems on the above.
- 1.7 Identify the various thermodynamic processes (Expansion & Compression of vapours)
- 1.8 Compute the work done, internal energy, enthalpy and entropy in each of the above processes.
- 1.9 Represent the above process on T-S and H-S diagrams
- 1.10 Calculate dryness fraction by using Steam calorimeters

2.0 Understand the Working of Steam Boilers

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- 2.1 State the function of boiler
 - 2.2 List out the uses of boilers
 - 2.2 Explain the working of Cochran Boiler with a legible sketch
 - 2.3 Explain the working of Babcock Wilcox Boiler with a legible sketch
 - 2.4 Distinguish between water tube and fire-tube boilers
 - 2.5 Recognise the need of high-pressure modern boilers
 - 2.6 Explain the working principle of Lamont and Benson Boilers with a legible sketch
 - 2.7 List all the boiler mountings
 - 2.8 Explain the function all the mountings with a legible sketch such as pressure gauge, water level indicator, safety valve and fusible plug.
 - 2.9 List all the boiler accessories.
 - 2.10 Illustrate the function of all the accessories with a legible sketch such as economiser, Super Heater, Steam traps & Separators.
 - 2.11 Explain the terms actual/equivalent evaporation and factor of evaporation.
 - 2.12 Define the boiler Power
 - 2.13 Define the boiler efficiency
 - 2.14 Write the formula for the above.
 - 2.15 Compute the equivalent and actual evaporation from given data.
 - 2.16 Solve problems on Boiler Power & efficiency
 - 2.17 Draw heat balance for boiler performance
 - 2.18 Explain draught systems (Natural, forced & induced) in detail with a legible sketch
- #### 3.0 Understand the Working of Steam Nozzles
- 3.1 Explain the flow of steam through nozzle
 - 3.2 Derive the expression for Velocity of steam at the exit of nozzle in terms of heat drop analytically and by using Mollier chart.
 - 3.3 Calculate Velocity of steam at the exit of nozzle in terms of heat drop analytically and by using Mollier chart.
 - 3.3 Write the expression for Discharge of steam through nozzles
 - 3.4 Write the formula for Critical pressure ratio
 - 3.5 Calculate cross-sectional areas at throat and exit for maximum discharge
 - 3.6 Explain the Effect of friction in nozzles and Super saturated flow in nozzles.
 - 3.7 Explain the Working of steam jet injector with a legible sketch.

- 3.8 Solve simple problems of nozzles.
- 4.0 Understand the Working of Steam Turbines**
- 4.1 Explain the principle of working of a turbine
- 4.2 Classify the Turbines with examples.
- 4.3 Differentiate the impulse turbines from reaction turbine
- 4.4 Explain the Principle of working of simple De-Laval turbine with a line diagram.
- 4.5 Draw velocity triangles
- 4.6 List the various blade angles
- 4.7 Derive formula for work done, axial thrust, energy lost, power and efficiencies.
- 4.8 State the necessity of compounding a turbine.
- 4.9 Describe the methods of reducing rotor speeds with the help of legible sketch (3 compounding methods)
- 4.10 Explain the working principle of Parson's Reaction Turbine with a line diagram.
- 4.11 Velocity triangle for Parson's reaction turbine.
- 4.12 Solve simple problems on Single stage Impulse turbines (without blade friction) and reaction turbines (including data on blade height)
- 4.13 Define the terms bleeding & reheating.
- 4.14 State the necessity of governing a turbine
- 4.15 Explain the methods of turbine governing
- 5.0 Understand the Working of Steam Condensers**
- 5.1 Define the Steam condenser
- 5.2 State the functions of steam condenser
- 5.3 Classify the condensers
- 5.4 Explain the working principle of Low level counter - Flow and Parallel - flow jet condensers with legible sketch
- 5.5 Explain the working principle of High level Jet condenser with legible sketch
- 5.6 List the Advantages and Disadvantages of High- Level Jet condenser
- 5.7 Explain the working principle of Ejector condenser with legible sketch
- 5.8 Explain the working principle of Shell and Tube Surface condenser with legible sketch
- 5.9 Distinguish between down flow and central flow surface condenser

- 5.10 Explain the working principle of Evaporative condenser with legible sketch
- 5.11 List the Advantages and Disadvantages of Surface condenser
- 5.12 Distinguish between Jet Condenser and Surface Condenser
- 5.13 Write the Formulae for cooling water required, Condenser efficiency, corrected vacuum, absolute pressure and Vacuum efficiency
- 5.14 Solve Simple problems on Steam condensers to Estimate the Cooling water required, Condenser efficiency and Vacuum efficiency
- 5.15 Define Air Extraction
- 5.16 List the types of Air Extraction systems
- 5.17 Distinguish between Dry-air Extraction and Wet-air Extraction systems
- 5.18 Explain the working principle of Air pump and Steam -Jet Air Ejector with legible sketch

COURSE CONTENT

1.0 Properties of steam

Formation of steam under constant pressure, dryness, fraction and degree of superheat, specific volume. Determination of enthalpy, internal energy, internal latent heat, entropy of wet, dry and superheated steam at a given pressure using steam tables and Mollier chart. Simple direct problems on the above using tables and charts. Vapour processes - simple problems using tables and charts. Steam calorimeters - Separating, throttling, Combined Separating and throttling calorimeters - problems.

2.0 Steam Boilers

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

3.0 Steam Nozzles

Flow of steam through nozzle. Velocity of steam at the exit of nozzle in

terms of heat drop by analytical and mollier diagram. Discharge of steam through nozzles. Critical pressure ratio. Methods of calculation of cross - sectional areas at throat and exit for maximum discharge. Effect of friction in nozzles and Super saturated flow in nozzles. Working steam jet injector. Simple problems of nozzles.

4.0 Steam Turbines

Classification of steam turbines with examples. Difference between impulse & reaction turbines. Principle of working of a simple De-Laval turbine with line diagrams. Velocity diagrams. Expression for work done, axial thrust, tangential force, blade and diagram efficiency, stage efficiency, nozzle efficiency. Methods of reducing rotor speed compounding for velocity, for pressure or both pressure and velocity. Working principle with line diagram of a Parson's Reaction turbine - velocity diagram. Simple problems on single stage impulse turbines (without blade friction) and reaction turbine including data on blade height. Bleeding, re- heating and re-heating factors (Problems omitted). Governing of steam turbines - Throttle, By-pass & Nozzle control governing.

5.0 Steam Condensers

Steam condenser, its functions, Classifications. Low level counter - Flow and parallel - Flow jet condensers, High level Jet condenser and Ejector condenser, Advantages and Disadvantages of High- Level Jet condenser. Shell and Tube Surface condenser, Down flow, Central flow Surface Condenser and Evaporative condenser, Advantages and Disadvantages of Surface condenser. The Formulae for cooling water required, Condenser efficiency, Corrected vacuum, Absolute pressure and Vacuum efficiency. Simple problems on Steam condensers to Estimate the Cooling water. Required, Condenser efficiency and Vacuum efficiency. Air Extraction, Types of Air Extraction systems, Dry-air Extraction and Wet-air Extraction systems, Air pump and Steam -Jet Air Ejector.

REDERENCE BOOKS

1. Thermodynamics by Ballaney
2. Elements of Heat Engines - Volume II by R.C. Patel & Karamchandani
3. Thermal Engineering by Arora & S. Domkundwar
4. Thermal Engineering by Roy & Sarao
5. Heat Engineering by Vasandani & Kumar

FLUID POWER CONTROL SYSTEMS

Subject Title	:	Fluid Power Control Systems
Subject Code	:	M-505
Periods/Week	:	04
Periods per Semester	:	60

TIME SCHEDULE

S No.	Major Topics	No. of Periods	Weightage of Marks	Short Answer Questions	Essay Type Questions
1	Introduction to Hydraulics	04	06	2	-
2	Hydraulic pumps	05	10	-	1
3	Hydraulic motors	05	10	-	1
4	Hydraulic actuators	08	13	1	1
5	Directional control valves	05	10	-	1
6	Pressure control valves	05	10	-	1
7	Flow control valves	04	06	2	-
8	Hydraulic circuit design and analysis	08	13	1	1
9	Introduction to pneumatics	04	06	2	-
10	Pneumatic actuators	06	13	1	1
11	Single actuator circuits	06	13	1	1
	Total	60	110	10	08

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OBJECTIVES

Upon completion of the course the student shall be able to

1.0 Understand the concept of Hydraulics and Pneumatics

- 1.1 Explain the meaning of fluid power.
- 1.2 List the various applications of fluid power.
- 1.3 Differentiate between fluid power and transport systems.
- 1.4 List the advantages and disadvantages of fluid power.
- 1.5 Explain the industrial applications of fluid power.
- 1.6 List the basic components of the fluid power.
- 1.7 Explain the meaning of Pneumatics.
- 1.8 Differentiate between electrical, pneumatic and fluid power systems.
- 1.9 Appreciate the future of fluid power in India.

2.0 Understand the concept of Hydraulic pumps

- 2.1 Classify the hydraulic pumps used in the industry.
- 2.2 Differentiate between positive displacement and non-positive displacement pumps.
- 2.3 Explain the working and construction of gear, vane and piston pumps.
- 2.4 Define mechanical, volumetric and overall efficiency of pumps.
- 2.5 Differentiate between internal and external gear pumps.

3.0 Understand the concept of Hydraulic motors

- 3.1 Differentiate between a hydraulic motor and a hydraulic pump.
- 3.2 List various applications of hydraulic motor in fluid power.
- 3.3 Discuss various classifications of hydraulic motor.
- 3.4 Explain the construction and working of gear, vane and piston motors.
- 3.5 Explain various types of efficiency terms used in hydraulic motors.
- 3.6 Determine the torque and power delivered by hydraulic motors

4.0 Understand the concept of Hydraulic actuators

- 4.1 Explain the classification of hydraulic actuators.
- 4.2 Explain various types of hydraulic cylinders.
- 4.3 Describe the construction and working of double-acting cylinders.
- 4.4 Derive an expression for force, velocity and power for hydraulic cylinders.
- 4.5 Analyze various lever systems using hydraulic cylinders.
- 4.6 Explain the importance of cylinder cushioning.

5.0 Understand the concept of Directional- control valves

- 5.1 List different types of valves used in fluid power.
- 5.2 Explain various classifications of directional control valves.
- 5.3 Describe the working and construction of various direction control valves.
- 5.4 Identify the graphic symbols for various types of direction control valves.
- 5.5 Explain the different applications of direction control valves.
- 5.6 Explain the working principle of solenoid-actuated valves.
- 5.7 Define valve overlap.
- 5.8 Evaluate the performance of hydraulic systems using direction control valves.

6.0 Understand the concept of Pressure- control valves

- 6.1 Explain various functions of pressure-control valves.
- 6.2 Explain various classifications of pressure-control valves.

- 6.3 Describe the working construction of various pressure-control valves.
- 6.4 Differentiate between a pressure relief valve, a pressure-reducing valve, a sequence valve and unloading valve.
- 6.5 Identify the graphic symbols for various types of pressure-control valves.
- 6.6 Explain different applications of pressure-control valves.

7.0 Understand the concept of Flow- control valves

- 7.1 Explain various functions of flow-control valves.
- 7.2 Explain various classifications of flow-control valves.
- 7.3 Describe the working and construction of various non-compensated flow-control valves.
- 7.4 Differentiate between compensated and non-compensated flow-control valves.
- 7.5 Identify the graphic symbols for various types of flow-control valves.
- 7.6 Explain different applications of flow-control valves.

8.0 Understand the concept of Hydraulic circuit design and analysis

- 8.1 Identify the graphic symbols for various types of hydraulic components.
- 8.2 Explain various hydraulic circuits to control single-acting and double-acting cylinders.
- 8.3 Explain a regenerative circuit and determine the load-carrying capacities.
- 8.4 Describe the working of a double-pump circuit along with its advantages.
- 8.5 Explain the working of a sequencing circuit and a counterbalancing circuit.
- 8.6 Differentiate between series and parallel synchronization circuits.

9.0 Understand the concept of Pneumatics

- 9.1 Explain the meaning of Pneumatics
- 9.2 Describe the various properties desired of a air medium in pneumatic system
- 9.3 Explain the advantages and disadvantages of compressed air
- 9.4 Identify and appreciate the application of pneumatic systems in various Industries
- 9.5 List the basic components required for a pneumatic systems
- 9.6 Describe the various power transmission systems
- 9.7 Compare hydraulic, pneumatic and mechanical systems

10.0 Understand the concept of Pneumatic actuators

- 10.1 Explain the meaning of Pneumatic Actuator
- 10.2 Classify the various types of Pneumatic actuators
- 10.3 Explain the working of various pneumatic actuators
- 10.4 Study the seals used in the Pneumatic actuators
- 10.5 Explain the working and application of air motors

11.0 Understand the concept of Single actuator circuits

- 11.1 Differentiate between pneumatic circuit and pneumatic circuit diagram
- 11.2 State basic rules used in design of pneumatic circuits
- 11.3 Explain the memory, delay, OR, AND and NOT functions
- 11.4 Explain the direct and indirect control of single acting cylinder
- 11.5 Explain the direct and indirect control of double acting cylinder
- 11.6 Differentiate supply and exhaust air throttling
- 11.7 Design pressure and time dependent circuits

COURSE CONTENT

- 1.0** Definition and scope of fluid power, Advantages and drawbacks of fluid power, Applications of fluid power, Components of Fluid power system - Hydraulic & Pneumatic systems Comparison between Hydraulic and Pneumatic Systems, Comparison of Different Power Systems -mechanical, electrical, hydraulic and pneumatic power systems, Future of Fluid power industry - in general and related to India
- 2.0** Classification of pumps based on Displacement, Delivery and Motion, Positive and Non-positive displacement pumps, Advantages and disadvantages of Non-positive displacement pumps Differences between Positive and Non-positive displacement pumps, Classification of positive displacement pumps Pumping Theory, Gear pumps - External and internal gear pumps, Lobe and Screw pumps, Advantages, Disadvantages and applications of the above pumps, Vane pumps -Unbalanced and Balanced vane pumps, Advantages, Disadvantages and applications of vane pumps, Piston Pumps - Axial and Radial Piston Pumps Bent - Axis type and Swash - P Advantages, Disadvantages and applications of vane pumps, plate type piston pumps, Advantages, Disadvantages and applications of piston pumps, Volumetric and Mechanical efficiencies of pumps

- 3.0** Introduction- Differences between hydraulic pump and motor, Applications of hydraulic motors, Comparison between hydraulic and electric motors, Classification of hydraulic motors, Gear motors, Vane motors, Piston motors, Theoretical torque, power and flow rate, Volumetric, Mechanical and Overall efficiencies of hydraulic motor
- 4.0** Introduction- Classification of actuators, Types of hydraulic cylinders - Single-acting - Gravity return and spring return single acting cylinders, Double-acting - Piston rod on one side and both the sides, Telescope and Tandem cylinders, Cylinder force, velocity and power, First, Second and Third Class lever systems used in cylinders, Cylinder cushions and its importance
- 5.0** Introduction to valves used in fluid power, Functions of direction control valves, Classification of direction control valves on different criteria, Classification of DCVs based on Fluid Path, Design Characteristics, Control Method, Construction of Internal Moving Parts, Symbols of various direction control valves, Different types of actuators - Manually operated, mechanically operated, Solenoid operated and Pilot operated actuators, Check valve - construction and operation details of Ball type, Poppet, Pilot operated and Solenoid actuated check valves, Two way and Three way control valves and their applications

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- 6.0** Necessity and functions of pressure control valves, Classification of pressure control valves, Pressure relief valves - construction and working of simple and compound (pilot operated) pressure relief valves, Pressure reducing valves, Unloading valves - Direct Acting and Pilot operated unloading valves - construction and operation, Counter balance valves, Pressure sequence valves, Cartridge valves - Balanced and unbalanced poppet controlled cartridge valves, Applications of pressure control valves
- 7.0** Functions of flow control valves, Classification of flow control valves, Construction and operation of Non - pressure compensated and Pressure compensated flow control valves
- 8.0** Describing the operation of complete hydraulic circuits drawn using graphic symbols for all components, Control of single - acting hydraulic cylinder, Control of double - acting hydraulic cylinder, Regenerative cylinder circuit - expression for the cylinder extending speed, Load carrying capacity during extension, Pump unloading circuit, Double - pump hydraulic circuit, Counter balance valve application, Hydraulic cylinder sequencing circuit, Cylinder synchronizing circuits - cylinders connected in parallel and series, Fail - safe circuits, fail - safe system with overload protection, Two - handed safety system

- 9.0** Introduction to Pneumatics, Choice working medium and system, Advantages and disadvantages of compressed air, Applications of pneumatics, Basic components of pneumatic systems, Advantages and disadvantages of pneumatic systems, Comparison of Mechanical / Electrical, Hydraulic and Pneumatic transmission systems
- 10.** Introduction to pneumatic actuators, Types of pneumatic actuators - Linear actuators (pneumatic cylinders), Rotary actuators (Air motors) and Limited angle actuators, Classification of Linear actuators based on, Application for which cylinders are used, cylinder's action, cylinder's movement and cylinder's design, Materials of construction for light, medium and heavy duty cylinders, Single acting cylinders - construction of Diaphragm cylinder, Rolling diaphragm cylinders, Gravity return and Spring return single acting cylinders, Construction of double - acting cylinders with piston rod on one side and both the sides, Telescopic cylinder, Tandem cylinder, Rodless cylinder, Cable cylinder, Sealing band Cylinder with slotted cylinder barrel, Cylinder with Magnetically Coupled Slide, Impact cylinders and Duplex cylinders, Graphic symbols of cylinders, Cylinder Seals - characteristics and classification, Static and Dynamic seals, Different types of cylinders used in cylinders, Working and applications of Air Motor
- 11.** Functions of the pneumatic circuits, Direct and indirect control of single acting cylinders, Control of single acting cylinder with OR, AND, NOT valves, Direct and indirect control of double acting cylinders, Control of double acting cylinders with Supply air - throttling, Exhaust air throttling, Time dependent controls - Time delay valve NC-type, Time delay valve NO-type

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

MACHINE TOOL ENGINEERING

Subject Title	:	Machine Tool Engineering
Subject Code	:	M-506
Periods Per Week	:	04
Periods Per Semester	:	60

TIME SCHEDULE

S.No	Major Topics	Number of Periods	Weightage of Marks	Short Answer Questions	Essay Type Questions
1	Modern Machining Process	16	29	03	02
2	Plastic processing	16	26	02	02
3	Press Tools, Jigs and Fixtures	20	42	04	03
4	Jig Boring	08	13	01	01
	Total	60	110	10	08

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OBJECTIVES

Upon completion of the course the student shall be able to

1.0 Understand the Modern Machining Processes

- 1.1 Distinguish between non-conventional machining processes and traditional methods.
- 1.2 State their relative advantages.
- 1.3 Explain the principle of working of ultrasonic machining.
- 1.4 List the equipment used in U.S.M. processes.
- 1.5 Explain the principle of electric discharge machining with a legible sketch.
- 1.6 Explain the working of Abrasive jet machining with a legible sketch
- 1.7 Explain the working of Laser beam machining with a legible sketch
- 1.8 State the principle of chemical machining.

2.0 Understand the concept of Plastic Processing

- 2.1 State the principle of manufacturing plastic products.
- 2.2 Explain the methods of injection moulding, compression moulding, transfer moulding with legible sketches

- 2.3 Explain the principle of extruding, casting and calendaring with legible sketches
- 2.4 State the principle of machining and welding plastics
- 2.5 Explain the different fabrication methods - Sheet forming, Blow moulding, Laminating and Reinforcing
- 2.6 List Engineering applications of plastics
- 3.0 Understand the use of Press Tools, Jigs and Fixtures**
- 3.1 Explain the Importance of Press Tools
- 3.2 Classify presses based on power and design of frame.
- 3.3 Explain the constructional details of a power press with the help of a legible sketch
- 3.4 State the meaning of Press size.
- 3.5 Explain Press Tools - Punch and die.
- 3.6 Explain Die-clearance and Die Accessories
- 3.7 Explain shear action in die cutting operation - Punch and die clearances, angular clearance, centre of pressure, cutting forces.
- 3.8 Explain various press working operations.
- 3.9 Explain different types of dies.
- 3.10 List various die operations
- 3.11 List types of jigs and explain their constructional details with the help of legible sketches
- 3.12 State general considerations in design of drill jigs
- 3.13 State the function of drill bush.
- 3.14 List different types of fixtures and explain their constructional details with the help of legible sketches.
- 3.15 Differentiate between jigs and fixtures.
- 3.16 List the advantages of Jigs and Fixtures
- 3.17 Explain basic principle of location.
- 3.18 Identify different locating methods and devices.
- 3.19 Explain the basic principle of clamping.
- 3.20 Identify different types of clamps and their constructional details with the help of legible sketches
- 4.0 Understand the process of Jig Boring**
- 4.1 List the situations where jig-boring machines are needed.
- 4.2 State the principle of working of a jig boring machine.

- 4.3 Explain the process of button boring on lathes.
- 4.4 Classify the jig boring machines.
- 4.5 Explain the constructional details of open front machine and cross rail type machine with the help of legible sketches.
- 4.6 Explain the function of above machines.
- 4.7 Describe the systems of location of holes.

COURSE CONTENT

1.0 Modern Machining Processes

Introduction - comparison with traditional machining, Ultrasonic machining Principle - Description of equipment - applications. Electric Discharge Machining Principle - Description of equipment - Type of EDM Processes - applications. Abrasive jet machining - principle - description of equipment - application. Laser beam machining - principle - description of equipment- application. Chemical machining - Principle - description of equipment - Applications.

2.0 Plastics Processing

Processing of plastics - Injection moulding - Compression moulding, Transfer moulding. Extruding, Casting, Calendaring Fabrication methods -Sheet forming methods, Blow moulding, Laminating plastics (sheets, rods & tubes). Tool angles for machining. Coolants used in machining of plastics - Applications of Plastics

3.0 Press Tools, Jigs and Fixtures

Introduction - Types of Presses - hand, power, gap, inclinable, adjustable, horn, straight side, and pillar presses. Constructional details of a power press - Press size. Press Tools - Punch and die, Die Accessories - Stops, Pilots, strippers, Knock outs, pressure pads. Shear action in die cutting operation - punch and die clearance and angular clearance, centre of pressure, cutting forces. 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.

Sheet metal bending: bending methods, spring back, bend allowance, bending pressure - sketches and empirical formulae. Types of dies meaning of inverted, progressive, compound and combination dies. material selection for punch and die. Definition of jig - Types of jigs - leaf jig, box and handle jig, template jig, plate jig, Indexing jig, Universal jig, vice jigs. Explain the constructional details of the above jigs. General consideration in the design of drill jigs. Explain drill bush

Types of fixtures : vice fixtures, milling fixtures, boring fixtures, grinding

fixtures - Explain the constructional details of the above fixtures. Basic principles of location - Explain the locating methods and devices. Explain the basic principles of the clamping - Types of clamps - strap clamps, cam clamps, screw clamps, toggle clamps, hydraulic and pneumatic clamps.

4.0 Jig Boring.

Introduction - Button boring on lathes- 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. Manufacturing Technology - Hajra Chowdhary Volume I & II
2. Manufacturing Technology - P.N.Rao Volume II
3. Production Technology - R.C.Patel
4. Production Technology - Jain & Gupta.
5. Tool Design - Donaldson

CAD PRACTICE

Subject Title	:	CAD Practice
Subject Code	:	M-507
Periods per week	:	06
Period per semester	:	90

TIME SCHEDULE

SI No.	Major Topics	No. of periods
1.	Introduction to CAD	03
2.	Selecting commands & Working with drawing	06
3.	Viewing drawing	03
4.	Working with coordinates	03
5.	Creating simple and complex entities	06
6.	Getting Drawing information	06
7.	Modifying entities	06
8.	Working with text	03
9.	Dimensioning drawing	03
10.	2D Drawing	21
11.	Layers	03
12.	Isometric views	06
13.	Working with blocks	03
14.	Printing drawing	03
15.	3D Drawings	15
TOTAL		90

OBJECTIVES

Upon completion of the course the student shall be able to

1.0 Understand about the Computer Aided Drafting and its software

- 1.1 Define Computer Aided Drafting
- 1.2 List the Advantages of CAD
- 1.3 Explain the importance of CAD software
- 1.4 Explain the features of Graphic Work station
- 1.5 Use CAD Environment: Screen, Various tool bars and menus.

2.0 Use appropriate selection commands

- 2.1 Practice commands using toolbars, menus, command bar

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- 2.2 Practice repeating a command, Nesting a command and modifying a command
 - 2.3 Use prompt history window and scripts
 - 2.4 Practice mouse shortcuts
 - 2.5 Practice the Creating the drawing, Opening existing and damaged Files, saving the drawing
 - 2.6 Practice the setting up a drawing
 - 2.7 Practice the setting and changing the grid and snapping alignment
 - 2.8 Practice the Entity snaps
 - 3.0 Use viewing tools of CAD**
 - 3.1 Practice the use of Scroll bar, pan command, and rotating view to move around within drawing
 - 3.2 Practice the changing of magnification of drawing
 - 3.3 Practice the displaying of multiple views
 - 3.4 Practice the use of controlling visual elements like Fill, Text, Blips and Line weight
 - 4.0 Use coordinate systems of the drawing**
 - 4.1 Practice how the coordinate system work
 - 4.2 Practice how the coordinate system displayed
 - 4.3 Practice the Find tool to determine the coordinates of a point
 - 4.4 Practice the Two dimensional coordinates such as Absolute Cartesian, Relative Cartesian and Polar coordinates
 - 4.5 Practice the use of right-hand rule
 - 4.6 Practice the how to enter into x, y, z - coordinates
 - 4.7 Practice the Three dimensional coordinates such as Spherical and Cylindrical coordinates
 - 4.8 Practice the use of filters in two and three dimensions
 - 4.9 Practice the defining user coordinate system
 - 4.10 Practice the use of present user coordinate system
 - 5.0 Create the simple and complex entities**
 - 5.1 Draw the lines, circles, arcs, ellipses, elliptical arcs, rays and infinite lines
 - 5.2 Practice the Creation of point entities
 - 5.3 Practice the Editing of point entities
 - 5.4 Draw the complex shapes like Rectangles, Polygons, Polylines, Splines, Donuts, Planes

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- 5.5 Practice the adding of hatch pattern
 - 6.0 Use the drawing information retrieving tools Measure, Divide, Calculate, Display, and Track**
 - 6.1 Measure the intervals on entities
 - 6.2 Divide the entities in to segments
 - 6.3 Calculate the areas defined by points, of closed entities, and Combined entities
 - 6.4 Calculate the distance between the entities
 - 6.5 Calculate the angle between the entities
 - 6.6 Display the information about the entities and drawing status
 - 6.7 Track time spent working on a drawing
 - 7.0 Use the modifying tools to modify the properties of entities**
 - 7.1 Practice the entity selection and deselection methods
 - 7.2 Practice the Deletion of entities
 - 7.3 Practice the Copying of entities within a drawing, between drawings
 - 7.4 Practice the making of parallel copies, Mirroring entities and Arraying entities
 - 7.5 Practice the Rearranging of entities by Moving, Rotating and Reordering
 - 7.6 Practice the Resizing of entities by Stretching, Scaling, Extending, Trimming, and Editing the length
 - 7.7 Practice the Braking and joining of entities
 - 7.8 Practice the creating, modifying the groups and ungrouping of Entities
 - 7.9 Practice the Editing of polylines: Opening, Closing, Curving, Decurving, Joining, Changing width and editing vertices
 - 7.10 Practice the Exploding of entities
 - 7.11 Practice the Chamfering and Filleting of entities
 - 8.0 Use the Text tool to create and formatting the various types of text fonts and its styles**
 - 8.1 Practice the creating, naming and modifying the text fonts
 - 8.2 Practice the Creation of line text, paragraph text
 - 8.3 Practice the Setting of line text style and its alignment
 - 8.4 Practice the Setting of Paragraph text style and its alignment
 - 8.5 Practice the Changing of line text and Paragraph text
 - 8.6 Practice the use of alternate text editor
 - 9.0 Use Dimensioning concepts to create dimensions, Edit dimensions,**

Control dimension styles & variables and Adding geometric tolerances

- 9.1 Practice the creating of linear, Angular, Diametral, Radial, Ordinate dimensions
- 9.2 Practice the creating leaders and annotations
- 9.3 Practice the making dimensions oblique
- 9.4 Edit the dimension text
- 9.5 Practice the Controlling of dimension arrows and format
- 9.6 Practice the Controlling of line settings and dimension text
- 9.7 Practice the Controlling of dimension units, and dimension tolerance

10.0 Create 2D Drawings

- 10.1 Create 2D drawings of standard mechanical components

11.0 Organize the information on layers

- 11.1 Practice the setting a current layer, layers color, line type, line weight, print style
- 11.2 Practice the locking and unlocking of layers
- 11.3 Practice the layer visibility and layer printing
- 11.4 Practice the setting of current line type
- 11.5 Practice the loading of additional line types
- 11.6 Practice the creating and naming of line type
- 11.7 Practice the editing of line type

12.0 Create Isometric Views

- 12.1 Create Isometric views of simple objects

13.0 Use the Blocks, Attributes and External references to manage the Drawing

- 13.1 Define a block
- 13.2 Explain the purpose of a block
- 13.3 Practice the creating a block
- 13.4 Practice the inserting a block
- 13.5 Practice the redefining a block
- 13.6 Practice the exploding a block
- 13.7 Define an Attribute
- 13.8 Practice the editing attribute definitions
- 13.9 Practice the attaching attribute to blocks
- 13.10 Edit attributes attached to blocks

- 13.11 Extract attributes information
- 13.12 Define external reference
- 13.13 Practice the Attaching, Removing, and Reloading of external references
- 13.14 Practice the Binding, Clipping and changing the path of external references

14.0 Use Layouts, Layout view ports, and customizing printing in CAD

- 14.1 Define layout for printing
- 14.2 Understand the layouts
- 14.3 Practice the viewing of drawings in paper and model space
- 14.4 Display the model and layout tabs
- 14.5 Create the new layout
- 14.6 Reuse the layouts from other files
- 14.7 Manage the layouts in a drawing
- 14.8 Define layout view ports
- 14.9 Create layout view ports
- 14.10 Practice the viewing and scaling of layout view ports
- 14.11 Modify the layout viewports
- 14.12 Select the appearance of print dialog
- 14.13 Set the paper size and orientation
- 14.14 Select a printer or a plotter
- 14.15 Set the scale and view
- 14.16 Choose how line weight print

15.0 3D Drawings

- 15.1 Explain the concept of 3D
- 15.2 Create 3D solids using solid tool bar options
- 15.3 Create 3D Drawings of Standard Mechanical Components
- 15.4 Practice Rendering

KEY competencies to be achieved by the student

S.No	Experiment Title	Key Competency
1.	Introduction to CAD	<ul style="list-style-type: none"> Open/close Autocad program Understands Autocad Graphic User Interface(GUI) and various toolbars
2.	Selecting commands & Working with drawing	<ul style="list-style-type: none"> Use prompt history window and scripts Practice the setting up a drawing Practice the Entity snaps
3.	Viewing drawing	<ul style="list-style-type: none"> Use Scroll bar, pan command, and rotating view to move around within drawing Control visual elements like Fill, Text, Blips and Line weight
4.	Working with coordinates	<ul style="list-style-type: none"> Use Two dimensional coordinates and Three dimensional coordinates Use right-hand rule Use filters in two and three dimensions Define user coordinate system
5.	Creating simple and complex entities	<ul style="list-style-type: none"> Draw the simple shapes like lines, circles, arcs and complex shapes like polygons, planes etc., Practice the adding of hatch pattern
6.	Getting Drawing information	<ul style="list-style-type: none"> Measure the intervals and distance between entities Divide the entities in to segments Calculate the areas defined by points, of closed entities, and Combined entities
9.	Dimensioning drawing	<ul style="list-style-type: none"> Create linear, Angular, Diametral, Radial, Ordinate dimensions Practice the making dimensions oblique Edit the dimension text Practice the Controlling of dimension units, and dimension tolerance
10.	2D Drawings	<ul style="list-style-type: none"> Use proper 2D commands to create 2D drawings
12.	Isometric Views	<ul style="list-style-type: none"> Use Iso snap command to create Isometric views
13.	Working with blocks	<ul style="list-style-type: none"> Create , insert and explode a block Attach attribute to blocks Edit and extract attributes attached to blocks
14.	Printing drawing	<ul style="list-style-type: none"> Display the model and layout tabs Create the new layout and Manage the layouts from other files Practice the viewing, scaling and Modifying of layout view ports Set the paper size, orientation, scale, view and line weight to print
15.	3D Drawings	<ul style="list-style-type: none"> Region 2D Drawings Use proper 3D commands to create 3D drawings

COURSE CONTENT**1.0 The Computer Aided Drafting and its software**

Definition of Computer Aided Drafting, the Advantages and importance of CAD software, the features of Graphic Work station, CAD Environment: Screen, Various tool bars and menus.

2.0 Selection of commands

Commands using toolbars, menus, command bar. Repeating a

command, Nesting a command and modifying a command. Use of prompt history window and scripts, mouse shortcuts. Creating the drawing. Opening existing and damaged files, saving of drawing, setting up a drawing. Setting and changing the grid and snapping alignment, and the Entity snaps.

3.0 Use of viewing tools of CAD

Use of Scroll bar, pan command, and rotating view to move around within drawing, changing of magnification of drawing. Displaying of multiple views, the use of controlling visual elements like Fill, Text, Blips and Line weight.

4.0 Use of coordinate systems of the drawing

Two dimensional coordinates such as Absolute, Cartesian, Relative Cartesian and Polar coordinates. The use of right-hand rule. Three dimensional coordinates such as Spherical and Cylindrical Coordinates, the use of filters in two and three dimensions, Defining user Coordinate system.

5.0 Creating simple and complex entities

Drawing of lines, circles, arcs, ellipses, elliptical arcs, rays and infinite lines. Creating and editing of point entities. Drawing of complex shapes like rectangles, polygons, polylines, Splines, donuts, planes, and adding of hatch pattern

6.0 Use the drawing information retrieving tools Measure, Divide, Calculate, Display, and Track

Measuring the intervals on entities, dividing the entities in to segments. Calculation of areas of defined by points, closed entities, and combined entities, calculate the distance and angle between the entities. Displaying the information about the entities and drawing status. Tracking time spent working on a drawing.

7.0 Use the Modifying tools to modify the properties of entities

Entity selection and de selection methods, the Deletion of entities. Copying of entities within a drawing, between drawings, parallel copies, Mirroring entities and Arraying entities. The Rearranging of entities by Moving, Rotating and Reordering. The Resizing of entities by Stretching, Scaling, Extending, Trimming, and Editing the length. The Braking and joining of entities, The creating, modifying the groups and Ungrouping of Entities. Editing of polylines: Opening, Closing, Curving, Decurving, Joining, Changing width and editing vertices, The Exploding of entities, the Chamfering and Filleting of entities

8.0 Use the Text tool to create and formatting the various types of text Fonts and its styles

The creating, naming and modifying the text fonts, the Creation of line text,

paragraph text, setting of line text style and its alignment. The Setting of Paragraph text style and its alignment, the Changing of line. Text and Paragraph text, the use of alternate text editor.

9.0 **Use Dimensioning concepts to create dimensions, Edit dimensions, Control dimension styles & variables and Adding geometric tolerances**

The creating of linear, Angular, Diametral, Radial, Ordinate dimensions. The creating leaders and annotations, making dimensions oblique, Editing the dimension text, controlling of dimension arrows and format. The Controlling of line settings and dimension text, the Controlling of dimension units, and dimension tolerance.

10.0 **2D Drawings**

Using appropriate commands creation of 2D drawings of standard mechanical components.

11.0 **Organize the information on layers**

Setting a current layer, layers color, line type, line Weight, print style Locking and unlocking of layers, the layer visibility and layer printing. Setting of current line type. The loading of additional line types, creating and naming of line type, editing of line type.

12.0 **Isometric Views**

Create Isometric views of simple objects

13.0 **Use the Blocks, Attributes and External references to manage the Drawing Blocks**

The purpose of a block, creating a block, inserting a block, redefining a block, exploding a block

Attribute

Editing attribute definitions, attaching attribute to blocks. Editing attributes attached to blocks, Extracting attributes information.

External reference

Attaching, Removing, and Reloading of external references. The Binding, Clipping and changing the path of external references.

14.0 **Use the Layouts, Layout view ports, and customizing printing in CAD layout for printing**

Layouts, Viewing of drawings in paper and model space, Displaying of model and layout tabs, creating the new layout, Reuse the layouts from other files, Manage the layouts in a drawing.

Define layout view ports

Create layout view ports. Practice the viewing and scaling of layout view ports, Modify the layout viewports.

Select the appearance of print dialog

Setting the paper size and orientation, selecting a printer or a plotter. Setting the scale and view, choosing line weight.

15.0 **3D Drawings**

3D drawings of standard components. Rendering of 3D images

REFERENCE BOOKS

4MCAD User Guide- IntellCAD Technology Consortium
(WWW.intellicad.org)

4MCAD Software:

1. 4MCAD Viewer,
2. 4MCAD Classic,
3. 4MCAD Standard,
4. 4MCAD Professional.

LIFE SKILLS
(Common to all branches)

Subject Title	:	Life skills
Subject Code	:	M - 508
Periods per week	:	03
Period per semester	:	45

TIME SCHEDULE

Sl No.	Major Topics	No. of periods
1.	Concept of life skills	03
2.	Enhancing self esteem	03
3.	Goal setting	03
4.	Positive attitude	03
5.	Managing emotions	06
6.	Stress management	06
7.	Time management	03
8.	Interpersonal skills	03
9.	Creativity	03
10.	Problem solving and Decision making skills	03
11.	Assertiveness	06
12.	Leadership skills & Team spirit	03
TOTAL		45

Note: No Written Examination

The students may be asked to demonstrate 1 or 2 skills from unit 2 to unit 12.

Marks: Internal – 40; External - 60

OBJECTIVES

On the completion of the course the students shall be able to

1.0 Understand the concept of Life Skills

- 1.1 Define Life Skills
- 1.2 Explain need and impact of Life Skills Programme
- 1.3 List the elements of Life Skills
- 1.4 Identify the sources of Life Skills

2.0 Understand the concept of Self esteem

- 2.1 Define the term self esteem
- 2.2 Explain the concept of Self esteem
- 2.3 List the characteristics of High Self esteem
- 2.4 List the characteristics of Low Self esteem
- 2.5 Explain the advantages of High Self esteem
- 2.6 Explain the behaviour patterns of Low self esteem
- 2.7 Explain the causes of Low self esteem
- 2.8 List the steps to build a positive Self esteem

Practicals

Exp No	Exercise	Activity (Questionnaire / Game and Role play)
1.	Identifying the Behaviour	<ul style="list-style-type: none"> • Identifying the behavior patterns of low self-esteem people.
2.	Practice Positive Self Esteem	<ul style="list-style-type: none"> • Steps to build a positive self esteem

3.0 Understand the concept of Goal setting

- 3.1 Define the term Goal
- 3.2 Explain the significance of Goal setting
- 3.3 Explain the following concepts
 - a) Wish b) Dream c) Goal
- 3.4 Explain the reasons for not setting goals
- 3.5 Explain effective goal setting process
- 3.6 List the barriers to reach goals

Practicals

Exp No	Exercise	Activity
1.	Differentiate among Wish, Dream and Goal	<ul style="list-style-type: none"> • Draw a picture of Your Self/ Your Country/ Your Society after 10yrs. • Discussion: Setting Personal Goals • Story Telling • Identifying of barriers • Analysis barriers • Overcoming barriers

4.0 Practise positive attitude

- 4.1 Define Attitude
- 4.2 Explain the concept of positive attitude
- 4.3 Explain the concept of negative attitude
- 4.4 Explain the effects of negative attitude
- 4.5 Identify the attitude of self and peers
- 4.6 Explain the effect of peers on self and vice-versa.
- 4.7 List the steps to enhance positive attitude
- 4.8 Explain the strategies to enhance positive attitude

Practicals

Exp No	Exercise	Activity (Psychological Instrument/ Game & Role play)
1.	Identify Positive attitude	<ul style="list-style-type: none"> • To study & to identify the attitude of self and peer • List & practise the strategies to enhance positive attitude.
2.	Observe	<ul style="list-style-type: none"> • Positive attitudes of self and Peers • Negative attitudes of self and Peers
3.	Practice Strategies to enhance Positive attitude	<ul style="list-style-type: none"> • Celebrating success • Listing successes

5.0 Practise managing emotions**5.1 Explain the concept of emotion**

- 5.2 List the different types of emotions
- 5.3 Differentiate between positive and negative emotions
- 5.4 Identify the type of emotion
- 5.5 Explain the causes of different types of emotions.

- 5.6 Implement methods to manage major emotions (anger / depression)
- 5.7 Define Emotional Intelligence.
- 5.8 Explain the method to enhance Emotional Intelligence.

Practicals

Exp No	Exercise	Activity (Story / simulated situational act /GD & Role play)
1.	Identify the Type of Emotion	<ul style="list-style-type: none"> • To identify the type and to study the cause of the emotion.
2	Managing Emotions	<ul style="list-style-type: none"> • Managing major emotions -Anger and Depression

6.0 Practise stress management skills

- 6.1 Define Stress
- 6.2 Explain the concept of stress
- 6.3 List the types of stress
- 6.4 Explain the causes of stress
- 6.5 Comprehend the reactions to stress
 - a) Physical
 - b) Cognitive
 - c) Emotional
 - d) Behavioural
- 6.6 Explain the steps involved in coping with stress by
 - a) Relaxation
 - b) Meditation
 - c) Yoga
- 6.7 Practice stress relaxing techniques by 3 methods.
 - a) Relaxation
 - b) Meditation
 - c) Yoga
- 6.8 Comprehend changing personality and cognitive patterns.
- 6.9 Observe changing personality and cognitive patterns.

Practicals

Exp No	Exercise	Activity(Questionnaire /Interview and practice)
1	Identify the type of stress	<ul style="list-style-type: none"> • To study & to identify the type and causes of stress.
2	Stress –Relaxation Techniques	<ul style="list-style-type: none"> • Practice some simple Stress –Relaxation Techniques, Meditation, Yoga.

Practise some simple Stress –Relaxation Techniques, Meditation, Yoga.

7.0 Practice Time Management Skills

- 7.1 Define Time management.
 7.2 Comprehend the significance of Time management.
 7.3 Explain the strategies to set priorities.
 7.4 List the steps to overcome barriers to effective Time management.
 7.5 Identify various Time stealers.
 7.6 Explain Time-Management skills.
 7.7 List different Time-Management skills.
 7.8 Comprehend the advantages of Time-Management skills.

Practicals

Exp No	Exercise	Activity (Group work and Games)
1	Identify Time stealers	<ul style="list-style-type: none"> Assign a activity to different Groups –Observe the time of accomplishing the task, Identify the time stealers.
2.	Practice Time-Management skills	<ul style="list-style-type: none"> Perform the given tasks- Games

8.0 Practise Interpersonal skills

- 8.1 Explain the significance of Interpersonal skills.
 8.2 List the factors that prevent building and maintaining positive relationships.
 8.3 Advantages of positive relationships.
 8.4 Disadvantages of negative relationships

Practicals

Exp No	Exercise	Activity
1.	Identify Relationships	<ul style="list-style-type: none"> Positive Relationships, Negative Relationships – Factors that affect them- Through a story
2.	Practise Rapport building	<ul style="list-style-type: none"> Exercises on Rapport building Developing Correct Body Language

9.0 Understand Creativity skills

- 9.1 Define Creativity
 9.2 List the synonyms like Invention, Innovation and Novelty
 9.3 Distinguish between Creativity , Invention, Innovation, and Novelty
 9.4 Discuss the factors that lead to creative thinking like observation and imitation , improvement etc.
 9.5 Distinguish between Convergent Thinking and Divergent Thinking
 9.6 Explain various steps involved in Scientific approach to creative thinking namely
 a) Idea generation b) Curiosity c) Imagination d) Elaboration e) Complexity
 f) Abstraction and simplification g) Divergent Thinking h) Fluency
 i) Flexibility j) Persistence k) Intrinsic Motivation l) Risk taking
 m) Projection/empathy n) Originality o) Story telling p) Flow.
 9.7 List the Factors affecting the creativity in Individuals.
 9.8 Give the concept of Vertical thinking and Lateral thinking.
 9.9 Explain the importance of Lateral thinking.
 9.10 Compare Lateral thinking and Vertical thinking

Practicals

Exp No	Exercise	Activity (Games and Group work)
1	Observe any given object	<ul style="list-style-type: none"> Identifying finer details in an object
2.	Imagine	<ul style="list-style-type: none"> Imagining a scene Modifying a story (introduce a twist) Improving a product Finding different uses for a product
3	Skills	<ul style="list-style-type: none"> Making paper craft
4	Product development	<ul style="list-style-type: none"> Brain storming session
5	Developing originality	<ul style="list-style-type: none"> Come up with original solutions for a given problem

10.0 Understand Problem Solving and Decision Making Skills

- 10.1 Define a Problem

- 10.2 Analyze the performance problems
 10.3 Categorize the problems
 10.4 List the barriers to the solutions to problems.

Practicals

Exp No	Exercise	Activity (Brainstorming – checklist technique free association, attribute listing)
1	Gathering the facts and Data and Organizing the information.	<ul style="list-style-type: none"> Information gathering and organizing Identifying the solutions to the problem Identifying the barriers to the solutions Zeroing on Optimum solution
2.	Problem solving	<ul style="list-style-type: none"> Games on Problem solving

11.0 Understand Assertive and Non Assertive behaviour

- 11.1 List the 3 types of Behaviours 1. Assertive 2. Non assertive (passive) 3. Aggressive Behaviour 4. Submissive behaviours
 11.2 Discuss the personality of a person having above behaviours
 11.3 Explain the usefulness of assertive behaviour in practical situations.
 11.4 Explain the role of effective communication in reflecting assertive attitude
 11.5 Give examples of Assertive statements a) Assertive request b) assertive NO
 11.6 Explain the importance of goal setting
 11.7 Explain the method of Conflict resolution.
 11.8 Discuss the methods of controlling fear and coping with criticism.

Practicals

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Exp No	Exercise	Activity (Simulated situational act)
1	Observation of behavior	<ul style="list-style-type: none"> Identifying different personality traits from the body language
2.	Practicing assertiveness	<ul style="list-style-type: none"> Write statements Reaction of individuals in a tricky situation Facing a Mock interview Detailing the characteristics of peers setting goals – Games like throwing a coin in a circle Giving a feedback on a)Successful program b) Failed project Self disclosure
3	Skills	<ul style="list-style-type: none"> Dealing with a critic Saying NO Dealing with an aggressive person
4	Simulation	<ul style="list-style-type: none"> Role play- skit 1. Assertive statements 2. goal setting 3. self disclosure

12.0 Practise Leadership Skills

- 12.1 Explain the concept of leadership
 12.2 List the traits of an effective leader
 12.3 Distinguish between Managing and leading
 12.4 List the 3 leadership styles
 12.5 Compare the above styles of leadership styles
 12.6 Discuss choice of leadership style
 12.7 Explain the strategies to develop effective leadership.
 12.8 Explain the importance of Decision making
 12.9 Explain the procedure for making effective decisions.

Practicals

Exp No	Exercise	Activity (Games and Group work)
1	Observation	<ul style="list-style-type: none"> Questionnaire
2.	Identification of a Leader	<ul style="list-style-type: none"> Give a task and observe the leader Discuss the qualities and his /her leadership style Ask the other members to identify the leadership qualities Reflection on the self
3	Skills	<ul style="list-style-type: none"> Decision making – followed by discussion
4	Building Team spirit	<ul style="list-style-type: none"> Motivation – Intrinsic and Extrinsic Training- Communication- Challenge

Competencies for Practical Exercises

S.No	Title	Competency	Key competencies
1.	Concept of life skills	<ul style="list-style-type: none"> Explain need and impact of Life skills 	
2.	Enhancing self esteem	<ul style="list-style-type: none"> Follow the steps to build a positive self esteem 	
3.	Goal setting	<ul style="list-style-type: none"> Practise the effective goal setting process 	
4.	Positive attitude	<ul style="list-style-type: none"> Practise the steps to enhance positive attitude. Observe the effects of peers on self and vice-versa. 	Practise the steps to enhance positive attitude
5.	Managing emotions	<ul style="list-style-type: none"> Practise the steps to manage emotional intelligence Identify different types of emotions Exercise control over Emotions 	<ul style="list-style-type: none"> Identify different types of emotions
6.	Stress management	<ul style="list-style-type: none"> Practise stress management techniques 	
7.	Time management	<ul style="list-style-type: none"> Practise Time management techniques 	
8.	Interpersonal skills	<ul style="list-style-type: none"> Identify positive and Negative Relations 	
9.	Creativity	<ul style="list-style-type: none"> Lead a small group for accomplishment of a given task. Build positive relationships. 	<ul style="list-style-type: none"> Build positive relationships.
10.	Problem solving and Decision making skills	<ul style="list-style-type: none"> Identify the various Problem solving and Decision making skills Make appropriate decision 	<ul style="list-style-type: none"> Identify the various Problem solving and Decision making skills
11.	Assertive and non Assertive behaviour	<ul style="list-style-type: none"> Practise Assertive and non Assertive behavior 	
12.	Leadership skills	<ul style="list-style-type: none"> Exhibit Leadership skills 	<ul style="list-style-type: none"> Exhibit Leadership skills

COURSE CONTENT

1.0 Concept of life skills

Definition of life skills, Need and impact of life skills programme

2.0 Enhancing self esteem

Concept, Characteristics of high and low self esteem people, Advantages of high self esteem, Causes of low self esteem- Identification of behaviour patterns of low self esteem – Practice session of Questionnaire / Game -Steps to build positive self esteem – Practice session of Role play

3.0 Goal setting

Significance of goal setting, Concepts of Wish, Dream, and Goal Identify Wish, Dream, and Goal and differentiate among them. Reasons for not setting the goals, Barriers to reach goals, Identify Barriers, Effective goal setting process & Practise Effective goal setting

4.0 Positive attitude

concept effects of negative attitude, attitude of self and peers, effect of peers on self and vice-versa, steps to enhance positive attitude, strategies to enhance positive attitude

5.0 Managing emotions

Problem-definition, performance problems, Categorize the problems, barriers to the solutions to problems.

6.0 Stress management

concept of stress, Types of stress, causes of stress, reactions of stress, coping with stress, stress relaxing techniques, changing personality and cognitive patterns

7.0 Time management

Definition, significance of various Time stealers, Time management, strategies to set priorities, steps to overcome barriers, Time-Management skills- its advantages.

8.0 Interpersonal skills

Significance of Interpersonal skills, positive relationships- Advantages, negative relationships- Disadvantages

9.0 Creativity

Definition, Invention, Innovation, Novelty, Creative Thinking, observation and imitation, improvement, Expertise, skill, and motivation, components of Creativity, Convergent Thinking and Divergent Thinking, various steps involved in Scientific approach to creative thinking namely, Factors affecting the creativity in Individuals, Vertical Thinking and Lateral Thinking.

10.0 Problem solving and Decision making skills

Definition, performance problems –analysis, categorizing, barriers to the solutions to problems.

11.0 Assertive and non Assertive behaviour

Types of Behaviours – their characteristics, need for controlling and avoiding aggressive behaviours, making and refusing an assertive request – their evaluation, importance of goal setting, method of giving feed back.

12.0 Leadership skills

Concept, importance, Role of a Leader in an Organization, Traits of an effective leader, Managing and leading, leadership styles-their comparison, theories of leadership, strategies to develop effective leadership, importance of Decision making, concept of ethical leadership and moral development.

REFERENCE

- Robert Nlussier, Christopher F. Achua Leadership: Theory, Application, & Skill development: Theory, Application.

HYDRAULICS & PNEUMATIC LABORATORY PRACTICE

Subject Title : Hydraulics & Pneumatics Laboratory practice
Subject Code : M-509
Periods/Week : 03
Periods/Semester : 45

TIME SCHEDULE

S.No	Experiment Title	No. of periods
1	Venturimeter	03
2	Pipe friction	03
3	Pelton wheel	03
4	Kaplan turbine	03
5	Francis turbine	03
6	Reciprocating pump	03
7	Centrifugal pump	03
8	Identification of Pneumatic components	03
9	Direct control of a single-acting cylinder	03
10	Direct control of a double-acting cylinder	03
11	Speed control of a double-acting cylinder	03
12	Control of a double-acting cylinder with OR logic	06
13	Control of a double-acting cylinder with AND logic	06
Total		45

OBJECTIVES

Upon Completion of the Lab the student shall be able to

1.0 Practice the determination of Cd 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 Understand the concept of working of Pneumatic components

- 8.1 Explain Pneumatics
- 8.2 Identify & List Symbols used in Pneumatic circuits.
- 8.3 Explain the phenomena of compressed air for transmitting power.
- 8.4 State Pascal's law.
- 8.5 List all the pneumatic applications.
- 8.6 Define Pneumatic actuator.
- 8.7 Classify the actuators.
- 8.8 Explain Linear actuators and Rotary actuators.
- 8.9 Define valve.
- 8.10 List different types of valves.
- 8.11 Explain the function of a valve.
- 8.12 Identify the components of a valve.
- 8.13 Identify about ports and positions.
- 8.14 List the Applications of valves.

9.0 Understand about the working of Direct control of a Single-acting cylinder

- 9.1 Draw the circuit diagram for actuating a single-acting cylinder.
- 9.2 Select the suitable valve.eg:3/2 valve.
- 9.3 Connect 3/2 valve to the actuator.
- 9.4 Actuate the single-acting cylinder by operating 3/2 valve.

10.0 Understand about the working of Direct control of a Double-acting cylinder

- 10.1 Draw the circuit diagram for actuating a Double-acting cylinder.
- 10.2 Select the suitable valve.eg:4/2 valve.
- 10.3 Connect 4/2 valve to the actuator.

- 10.4 Actuate the double-acting cylinder by operating 4/2 valve.

11.0 Understand about the working of Speed control of a Double-acting cylinder

- 11.1 Draw the pneumatic circuit for controlling the speed of double-acting cylinder
- 11.2 Select 4/2 or 5/2 valve and a throttle valve.
- 11.3 Connect 4/2 valve and throttle valve as per the circuit.
- 11.4 Operate the 4/2 valve and adjust the throttle valve to control the speed of double-acting cylinder

12.0 Understand about the working of Control of a Double-acting cylinder with OR LOGIC

- 12.1 Draw the pneumatic circuit for controlling the speed of double- acting cylinder using OR logic.
- 12.2 Select two 3/2 valves and a shuttle valve(OR Valve).
- 12.3 Connect 3/2 valves and OR valves to the double- acting cylinder as per the circuit.
- 12.4 Operate either one of the 3/2 valves to control the speed of double-acting cylinder.

13.0 Understand about the working of Control of a Double-acting cylinder with AND LOGIC

- 13.1 Draw the pneumatic circuit for controlling the speed of double-acting cylinder using AND logic.
- 13.2 Select two 3/2 valves and AND valve.
- 13.3 Connect 3/2 valves and AND valves to the double-acting cylinder as per the circuit.
- 13.4 Operate two valves simultaneously to control the speed of double- acting cylinder.

Key competencies to be achieved by the student

Experiment Title	Key Competency
1. Calculation of coefficient of discharge of Venturimeter	<ul style="list-style-type: none"> Maintain constant head Record readings of U- tube manometer without parallax error Record time taken for collection of specific quantity of water Calculate discharge and coefficient of discharge of venturimeter Repeat experiment for different heads (discharge)
2. Determination of pipe friction	<ul style="list-style-type: none"> Ensure flow through pipe is full to remove air bubbles Record time taken for collection of specific quantity of water in tank Calculate pipe friction using formula
3. Pelton wheel	<ul style="list-style-type: none"> Start turbine by switching on jet of water slowly Apply load steadily Record load, speed Calculate power and efficiency of turbine Plot performance curves
4. Kaplan Turbine	<ul style="list-style-type: none"> Start turbine by switching on water supply Apply load steadily Record load, speed Calculate power and efficiency of turbine Repeat experiment by Varying load/speed; Plot performance curves
5. Francis Turbine	<ul style="list-style-type: none"> Start turbine by switching on water supply Apply load steadily Record load, speed Calculate power and efficiency of turbine Repeat experiment by Varying load/speed; Plot performance curves
6. Reciprocating Pump	<ul style="list-style-type: none"> Maintain steady flow in suction and delivery pipes Record suction and delivery pressure gauge readings Record time for collection of specific quantity of water, electrical meter reading (input power) Calculate indicated power and efficiency Vary the head (flow) and repeat experiment
7. Centrifugal Pump	<ul style="list-style-type: none"> Maintain steady flow in suction and delivery pipes Record suction and delivery pressure gauge readings Record time for collection of specific quantity of water, electrical meter reading Calculate indicated power and efficiency Vary the head (flow) and repeat experiment

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Experiment Title	Key Competency
8. Introduction to Pneumatics	<ul style="list-style-type: none"> Identify the components of a pneumatic circuits.
9. Direct control of a single-acting cylinder	<ul style="list-style-type: none"> Select the suitable valve. eg: 3/2 valve. Connect 3/2 valve to the actuator.
10. Direct control of a double-acting cylinder	<ul style="list-style-type: none"> Select the suitable valve. eg: 4/2 valve. Connect 4/2 valve to the actuator.
11. Speed control of a double-acting cylinder	<ul style="list-style-type: none"> Select two 3/2 valves and a shuttle valve (OR Valve). Connect 3/2 valves and OR valves to the double-acting cylinder as per the circuit.
12. Control of a double-acting cylinder with OR logic	<ul style="list-style-type: none"> Select two 3/2 valves and a shuttle valve (OR Valve). Connect 3/2 valves and OR valves to the double-acting cylinder as per the circuit.
13. Control of a double-acting cylinder with AND logic	<ul style="list-style-type: none"> Select two 3/2 valves and AND valve. Connect 3/2 valves and AND valves to the double-acting cylinder as per the circuit.

COURSE CONTENT

- Determination of Coefficient of discharge of Venturimeter.
- Determination of major losses in pipes due to friction.
- Determination of B.P. and efficiency of Pelton wheel.
- Determination of B.P. and efficiency of Kaplan turbine.
- Determination of B.P. and efficiency of Francis turbine.
- Determination of I.P. and overall efficiency of a reciprocating pump
- Determination of I.P. and efficiency of the Centrifugal pump
- Identify the Pneumatic components and its applications.
- An experiment on Direct control of a single-acting cylinder and to know the functioning of the equipment.
- An experiment on Direct control of a double-acting cylinder and to know the functioning of the equipment.
- An experiment on Speed control of a double-acting cylinder and to know the functioning of the equipment.
- An experiment on controlling the speed of a double-acting cylinder with OR logic and to know the functioning of the equipment.
- An experiment Control speed of a double-acting cylinder with AND logic and to know the functioning of the equipment.

REFERENCE BOOKS

- Course Material on Basic Pneumatic Controls- ATI, Vidyanager, Hyderabad
- Course Material on Applications of Pneumatics- TTTI, Extension centre, Hyderabad (NITTTR-ECH)

FIELD PRACTICES

Subject Title	:	Field Practices
Subject Code	:	M - 510
Periods per Week	:	06
Periods per Semester	:	90

TIME SCHEDULE**1. Production**

Project	Skill Exercise	Number of Periods
Measuring sizes with a vernier caliper	<ul style="list-style-type: none"> Measure the outside diameter, inside diameter of a bore Measure the width of a tongue Measure the length of a step Measure the depth of a stepped bore 	04
Filing practice	<ul style="list-style-type: none"> File the end of Drill base of 102x52x7 on all sides to remove material 1 mm 	04
Drilling practice	<ul style="list-style-type: none"> Drill through holes of 4X\varnothing6 (@ 6,6) from all the corners of the Drill base of 150x100x5 (Repeat the same procedure for Drill Guide) 	04
The above practices can be exercised by considering similar components fulfilling the above requirements		
Gear hobbing	<ul style="list-style-type: none"> Perform gear hobbing on a given MS job with OD \varnothing74, ID \varnothing17 and thickness 10mm, Take 1 module as teeth thickness (or) Performing spur gear cutting on a given MS job with OD \varnothing74, ID \varnothing17 and thickness 10mm, Take 1 module 	06
Manufacture of solid shaft	<ul style="list-style-type: none"> Turn and face the given cylindrical rod according to the dimensions Cut the key way on the above shaft for the flat key Make the seat to mount the bearing on the above shaft 	04
Cutting splines on the shaft	<ul style="list-style-type: none"> Turn and face the given cylindrical rod according to the dimensions Index the job using dividing head Cut the splines on the above shaft on milling machine 	04
Cutting straight teeth on the gear blank	<ul style="list-style-type: none"> Index the job using dividing head Cut the teeth on the gear blank on milling machine 	04

Project	Skill Exercise	Number of Periods
Manufacturing of square threaded screw	<ul style="list-style-type: none"> Turn and face the given cylindrical rod according to the dimensions Cut the square threads on the rod for given pitch using back gear of the lathe 	04
Preparing template for involute gear tooth	<ul style="list-style-type: none"> Understand the law of gearing Understand the properties and importance of involute profile 	04
Casting of flange coupling	<ul style="list-style-type: none"> Prepare the pattern Prepare the mould and core for the flange coupling Drill the holes on the casted flange Cut the key way in the hub of flange 	04

2. Fabrication

Project	Skill Exercise	Number of Periods
Fabrication of Almirahs and trunk boxes	<ul style="list-style-type: none"> Measure the gauge of the sheet with gauge plate Produce marking on sheet Cut the sheet as per marking Bend, weld the sheets Apply primer and paint 	04
Critical cases	<ul style="list-style-type: none"> List out the sequencing of job planning when you have received an oversized component 	04
Practically with the support of the process sheet proforma adopted. Eg:1.Supporting of heavy weight job by using Jigs & Fixtures 2.If the dia.of the rod is more while testing on a UTM the suitable jaws will be replaced for Holding		

3. Servicing

Project	Skill Exercise	Number of Periods
Repair and Maintenance of	<ul style="list-style-type: none"> Engines Eg:Differential,Gear box & M/c parts & its components,etc 	04
	<ul style="list-style-type: none"> Refrigeration and Air conditioning test rigs Eg:Evacuating & charging of the Refrigerant,etc 	04
	<ul style="list-style-type: none"> Pumps Eg:Inlet & outlet valves,foot valve,gland of a pump,etc. 	04
The visit may be arranged to the following:		
<ul style="list-style-type: none"> Tyre servicing centers Servicing and maintenance of Automobiles Refrigeration system in dairies Thermal power plants Workshops (RTC) 		

4. Human Resource management

Project	Skill Exercise	Number of Periods
Manpower requirement	<ul style="list-style-type: none"> Planning and Assessing man power Student will be guided to prepare the man power requirement in the laboratories by assessing the demand. Eg: Boring of a component with an authorised process sheet, etc Skilled technician-1, Store keeper-1, Transport Asst.-1, Helper-1	06
Note: The visit may be arranged to appropriate industry to collect the information		

5. Inventory management

Project	Skill Exercise	Number of Periods
Material requirement	<ul style="list-style-type: none"> Handle the Store House and its transactions Select the Appropriate Storehouse Equipment Use Appropriate methods to Preserve the Store house material Practice Replenishment of material Practice Identification of store materials Maintain Appropriate Records in Store Accounting Use Material Budgeting Techniques Use Techniques of Inventory control Practice Purchasing and Disposal procedures Use Quality control and Value Analysis Practice Negotiation procedures Use Transportation and Disposal procedures 	08
Note: The student has to identify the material requirement in his field of working and should have knowledge on purchasing, store maintenance and disposal of unserviceable & outdated components & equipment.		

6. Case studies

Project	Skill Exercise	Number of Periods
Conduct energy audit for workshop/Home/SSI unit	<ul style="list-style-type: none"> Collect information about energy utilization in a local industry. Identify energy saving measures (to be) taken up in the industry 	04
Note: The visit may be arranged to appropriate industry to collect the information		

6. Safety

Project	Skill Exercise	Number of Periods
Mock drill	<ul style="list-style-type: none"> Rescue the persons from crash Rescue the persons from Fire accident 	06
Eg: Fire Accident <ul style="list-style-type: none"> Knowledge & practice on fire extinguishers Using of sand buckets Informing to the fire fighting agency. 		
First Aid	<ul style="list-style-type: none"> Practice the First aid procedures 	04
Eg: Hitting of a shaper ram <ul style="list-style-type: none"> Cleaning the injured area with spirit Applying betadin over injury Temporary bandage over the injury Moving person to nearest hospital Artificial Respiration in case of electrical shock, etc 		
Note: Guest lectures by experts from industries may be arranged		

SKILLS

Up on completion of the skill session the student shall be able to

1.0 Measure the outside and inside diameters of a bore

- Check the condition of the caliper
- * Confirm the looseness of the locking screw
- * Clean every part of the caliper with rags
- * Close the jaws, and examine the opening through light
- * Check whether the zero points coincide

Measure Outside diameter

- Open out the movable jaw slightly more than the measurable size
- Place the jaws at right angles to the axis of the work piece
- Close the jaw over the work piece such that the nib of the jaws just slip from the point of contact
- Lock the nib and record the reading

Measure Inside diameter

- Open out the ribs of the vernier caliper slightly less than the measurable size.
- Place the nibs inside the bore surface such that the nibs are parallel to the axis of the work piece and centre of the bore

- Open out the nibs so as to make contact on the bore surfaces, and swing the nibs to measure the maximum value of the bore size
 - Lock the nib and record the reading
- 2.0 File the of Drill base of 151x101x6 on all sides to remove material 0.5 mm**
- Wear the apron
 - Check the raw material (Drill base) size as per the work sheet (151x101x6)
 - Select the suitable height of the vice
 - Clamp the work piece centrally across the base firmly in position
 - File surfaces flat and parallel to an accuracy of ± 0.05 mm
 - File angle to 90° to a try-square accuracy
 - Check for flatness and squareness using tri-square
 - Measure the specifications of job is to be 150x100x5
- 3.0 Drill through holes of 4X \varnothing 6 (@ 6, 6) from all the corners of the Drill base of 150x100x5**
- Wear the apron
 - Follow safety and procedural precautions
 - Check the Drill base for its size
 - Mark and locate the centres for the holes to be drilled
 - Mount the job in a machine vice, using parallels and clamp it securely
 - Set the work table in such a manner that the drill can be fixed and removed without disturbing the vice or table
 - Fix a centre drill on the chuck in a drilling machine spindle and align with the centre mark on the job
 - Spot the hole location with the centre drill
 - Remove the centre drill and fix the required drill of $\varnothing 6$ without disturbing the vice or table
 - Perform an operation of drilling a hole of a diameter of $\varnothing 6$ up to a depth of 1mm for first go
 - Operate a coolant pump
 - Drill through hole as per requirement
- 4.0 Perform gear hobbing on a given MS job with OD- $\varnothing 74$, ID- $\varnothing 17$ and Thickness 10mm, Take 1 module as teeth thickness**

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- Wear the apron
 - Check the raw material specifications OD- $\varnothing 74$, ID- $\varnothing 17$ and thickness 10mm size as per the work sheet
 - Fix the job on appropriate mandrel using watchers and ensure that the one side of mandrel to be fitted in the cullet of the Miller and another side should be tightened using nut
 - Fix the 1 module cutter(Gear hobber) specified as 00.81 M200 LA , 00 571 800 PA
 - Set the index table to suit the cutter specifications
 - Set the feed as 0.15 mm / rev as per the Gear train chart
 - Set the speed as 624 m/min for the material MS EN8 as per the speed chart
 - Switch on the machine to perform the operation i.e Gear hobbing
 - Ensure that the operation is completed in 08 min
 - Take care of safety and procedural precautions
 - Remove the chips from the job
 - Clean the machine
 - Remove the job with mandrel from machine cullet
- 5. Understand the Material Requirement plan (Note: The faculty in charge needs to plan appropriate situation to accomplish the given exercises)**
- Handle the Store House and its transactions
1. Draw a typical layout of storeroom considering
 - a) Optimum utilization of space
 - b) Easier accessibility to all materials
 - c) Maximum security of all materials
 - d) Minimization of spoilage and damage
 2. Select appropriate Store depot based on their function and utility
 - a) For minimum possible stocks of spares, Equipments, Tools
 - b) If regular supplies are received, Un-necessary hold- ups and delays in work are avoided
- CSD - Central Store Depot
 - BSD - Branch Store Depot
 - TSD - Tool Store Depot
 - Select the Appropriate Storehouse Equipment

1. Identify storeroom equipment for a given materials
2. Group the articles according to their nature of storage
3. Arrange appropriate racks to store various materials like Bar, Tubes, Angles, Plate, Sheet, Tyre and Drum
4. Use Various measuring equipment to receive the different types of material
5. Which type of material handling equipment do you select, If you are given the following materials
 - a) Bricks
 - b) Reels of wire
 - c) Drums
 - d) Bales of paper
6. **Which type of material handling equipment do you select to lift the machines of 2 to 6 tonnes up to the height of 40 feet**
 - Use Appropriate methods to Preserve the Store house material
1. Preserve the following material according to the manufacturing criteria, degree of temperature and duration
 1. Metals
 2. Timber
 3. Textiles
 4. Rubber goods
 5. Chemicals
 6. Leather goods
2. Maintain Replenishment of stock by fixing
 - a) Maximum level
 - b) Minimum level
 - c) Order level
 - d) Danger level
- **Practice Replenishment of material**
Represent graphically the Working stock and Safety stock in Replenishment of material
- **Practice Identification of stores**
 1. Classify and Use Identification system for a given Raw material, Consumables, Machines and Equipment, Inflammable stores, Chemicals, Furniture, General stores, Scrap materials, Packaging materials, Fuel stock

- **Maintain Appropriate Documents in Store Accounting**
 1. Prepare the Documents for recording of Receipt of material
 - a) Material Receipt book
 - b) Material Receipt Note
 - c) Daily Receipt Voucher
 - d) Damage/Shortage/Excess Report
 - e) Package slip
 - f) Bin Card
 - g) Stock Ledger
 - h) Stock Identification Card
 2. Prepare the Documents for recording of Inspection of material
 - a) Purchase order
 - b) Daily Receipt Voucher
 - c) Inspection Note
 - d) Rejection Note
 - e) Bin Card
 - f) Stock Ledger
 - g) Stock Identification Card
 3. Prepare the Documents for recording of Issue of material
 - a) Material Requisition Slip
 - b) Bin Card
 - c) Gate pass
 - d) Stock Ledger
 - e) Stores Advice Note
 4. Prepare the Documents for recording of Verification of Stores
 - a) Stock- Taking Sheet
 - b) Stock Valuation Sheet
 - c) Bin Card
 - d) Material Transfer Note
 - e) Material Return Note
 - f) Stock Ledger
 5. Prepare the Documents for recording of Material Control
 - a) Stock Day sheet

- b) Stock Ledger Card
c) Kardex Card
- **Use Material Budgeting Techniques**
 1. Practice the Estimation of Consumption and Purchase of materials of a given Organization
 2. Use the Techniques for Drawing up a Material Budget of a given Organization.
 - **Use Tools and Techniques of Inventory control**
 1. Practicing of Estimation of Consumption and Purchase of materials of a given Organization
 2. Use the Techniques for Drawing up a Material Budget of a given
 - **Use Tools and Techniques of Inventory control**
 1. Practice the Estimation of Inventory carrying cost, Stock-out Cost and Control levels of a given Organization.
 2. Use the Tools and Techniques of Inventory control
 3. Prepare the Stock Control Card
 - **Practice Purchasing and Disposal procedures**
 1. Practicing the purchasing principles of six 'R's'.
 - a) Right Quality
 - b) Right Quantity
 - c) Right Time
 - d) Right Price
 - e) Right place, and
 - f) Right Source
 2. Use the Various Order Quantities in purchasing and Disposal
 3. Practicing the use of purchasing systems considering legal aspects of purchasing
 4. Practicing the use of the following documents in purchase procedure
 - a) Purchase Requisition
 - b) Purchase Enquiry
 - c) Suppliers Quotation
 - d) Comparative statement
 - e) Purchase Order
Bill / Invoice

- **Use Quality control and Value Analysis**
 1. Practicing the use of the following Methods of describing quality of the product
 - a) Samples
 - b) Brand name
 - c) Specifications
 - d) Grades
 2. Use the Five stages of Quality control for an effective accomplishment of Onerous task
 3. Practicing the use of Techniques of Value Analysis in reducing the product cost
 - a) EKCHANGE, and
 - b) MISS
 - **Practice Negotiation procedures**
 1. Practice the Phases of Negotiation
- [Note: Arrange a practicing session between two parties]**
- **Use Transportation and Disposal procedures**
 1. Practicing the following tasks to be carried out for effective transportation of goods of an enterprise Estimation of
 - a) Cost of transportation
 - b) Commodity value
 - c) Size of Shipment
 - d) Distance control
 - e) Type of Transport
 - f) Speed
 2. Practicing the appropriate Disposal procedures
 - a) Surplus Items
 - b) Obsolete Items
 - c) Scrap Items

6TH SEMESTER

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DIPLOMA IN MECHANICAL ENGINEERING SCHEME OF INSTRUCTIONS AND EXAMINATIONS VI Semester/(THIRD YEAR)

Subject Code	Name of the Subject	Instruction period / week		Total Period / year	Scheme of Examination			
		Theory	Practical/ Tutorial		Duration (hours)	Sessional Marks	End Exam Marks	Total Marks
THEORY:								
M-601	Entrepreneurship and Project Management	4	-	60	3	20	80	100
M-602	Refrigeration & Air Conditioning	5	-	75	3	20	80	100
M-603	Energy Sources & Power Plant Engineering	4	-	60	3	20	80	100
M-604	CAM	3	-	45	3	20	80	100
M-605	Measurement & Control Systems	5	-	75	3	20	80	100
M-606	Automobile Engineering	4	-	60	3	20	80	100
PRACTICAL:								
M-607	CAM Lab Practice	-	4	60	3	40	60	100
M-608	T.E and R & AC Lab Practice	-	3	45	3	40	60	100
M-609	Manufacturing & Servicing and Maintenance Lab Practice	-	3	45	3	40	60	100
M-610	Project work	-	7	105	3	40	60	100
TOTAL		25	17	630		280	720	1000

Note: 1. Five number of local industrial visits / Interaction, one from each of the courses listed from M 602 to 606 may be arranged to enable the students to have industry exposure.

2. Duration: Total of all the visits not exceeding one week

- The students need to submit 2-3 page write up mentioning all salient learning experiences like advance in technology, its evaluation, application, advantages & disadvantages, expected changes in future etc.,.

3. Industries: Advanced manufacturing industry / BHEL / HAL / BDL / Ordnance factory Central air conditioning units.

ENTREPRENEURSHIP AND PROJECT MANAGEMENT

Subject Title	:	Entrepreneurship and Project Management
Subject Code	:	M-601
Periods/Week	:	04
Periods per Semester	:	60

TIME SCHEDULE

S. No.	Major Topics	Periods	Weightage Of Marks	Short Answer Questions	Essay Type Questions
1.	Role of Entrepreneur and Entrepreneurial Development	12	26	02	02
2.	Marketing ,Sales & Feasibility study	12	26	02	02
3.	Industrial legislation & safety	18	29	03	02
4.	Introduction to ISO 9000 & T.Q.M.	18	29	03	02
Total		60	110	10	08

OBJECTIVES

Upon completion of the course the student shall be able to

1.0 Understand the role of entrepreneur in economic development and in improving the quality of life

- 1.1 Explain the concepts of Entrepreneurship.
- 1.2 Define the word entrepreneur.
- 1.3 Explain the role of Entrepreneurship.
- 1.4 List the qualities of an entrepreneur.
- 1.5 Explain the requirements of an entrepreneur.
- 1.6 Outline the expectations of Entrepreneurship.
- 1.7 Explain the role of entrepreneurs in promoting Small Scale Industries.
- 1.8 Explain the details of self-employment schemes.
- 1.9 Explain the method of product selection.
- 1.10 Explain the method of site selection.
- 1.11 Outline the method of plant layout.
- 1.12 State the needs for a planned and co-ordinated effort.

- 1.13 State the importance of follow up.
- 1.14 Describe the small business scheme.
- 1.15 List the financial assistance programmes.
- 1.16 List the organisations that help an entrepreneur.
- 2.0 Understand marketing, sales and feasibility study
- 2.1 Explain marketing functions.
- 2.2 Explain Sales function.
- 2.3 List out market conditions
- 2.4 Differentiate Sellers and Buyers' market.
- 2.5 Differentiate monopoly, oligarchy, and perfect competition.
- 2.6 Explain the conduct of demand surveys
- 2.7 Explain the conduct of a market survey
- 2.8 Differentiate product and production analysis.
- 2.9 List the input materials, i.e. Bill of materials
- 2.10 Define the main policy requirements
- 2.11 Explain the selection of site
- 2.12 Evaluate Economic and Technical factors
- 2.13 Prepare feasibility study
- 2.14 List different products currently in demand with market or industry
- 2.15 Explain Role of advertising, media of advertising and selection of media
- 3.0 Comprehend the provisions of industrial legislation in India. & Safety procedures**
- 3.1 Describe employer and employee relations.
- 3.2 Describe the mechanics of Trade Unions.
- 3.3 Describe mechanics of settlement of in outs.
- 3.4 Explain the significance of collective bargain.
- 3.5 List Welfare activities.
- 3.6 List subsidy schemes.
- 3.7 Explain the total welfare concept.
- 3.8 List the rights and responsibilities of employees and employers.
- 3.9 List the salient features of Indian Factories Act.
- 3.10 List the salient features of Minimum Wages Act.
- 3.11 List the salient features of Industrial Disputes Act.

- 3.12 List the salient features of Workmen's Compensation Act
- 3.13 List the salient features of E. S .I. Act.
- 3.14 List the salient features of consumer protection rights Act
- 3.15 Explain the importance of safety at Work place.
- 3.16 Explain the significance and mechanics of safety education.
- 3.17 Explain hazard and accident
- 3.18 List different hazards in the Industry
- 3.19 Explain the causes of accidents
- 3.20 Explain the direct and indirect cost of accidents.
- 3.21 List types of fire extinguishers
- 3.22 Describe the method of artificial Respiration.
- 3.23 List provisions of Indian Electricity Rules laid in the electricity act1923.

4.0 Understand ISO 9000 & TQM.

- 4.1 Explain the concept of quality.
- 4.2 List the quality systems and elements of quality systems.
- 4.3 State the principles of quality Assurance.
- 4.4 State the Indian Standards on quality systems.
- 4.5 List the evolution of ISO standards.
- 4.6 Explain ISO standards and ISO 9000 series of quality systems.
- 4.7 State the constituents of ISO 9000 series of standards for quality systems.
- 4.8 State the outstanding features and drawbacks of ISO 9000 series of standards.
- 4.9 List the beneficiaries of ISO 9000.
- 4.10 Explain 5-S principles and ZERO DEFECT.

COURSE CONTENT

1. Role of Entrepreneur & Entrepreneurial Development.

Concept, definition, role, expectation, entrepreneurship vs management, promotion of SSI, self employment schemes, product selection, site selection, plant layout, profile and requirement, institutional support needed, financial assistance programmes.

2. Marketing, Sales & Feasibility Study

Sellers and Buyers markets, Marketing, Sales, Market conditions, monopoly, oligarchy, perfect competition, Budgets, Pricing Policies. Market Survey, Product and production Analysis, Materials input, Manpower,

Location, Economic and Technical Evaluation, preparation of Feasibility study reports, - different products - Mechanical, Electrical, Electronics, consumer items, Consumer desires etc.

3. Industrial Legislation and safety

Employer - Employee relations, Trade, Union Settlement of disputes, collective bargaining, Welfare activities, subsidies, Total Welfare concept, rights and responsibilities and Employers and employees. Salient features of (i) Indian Factories Act, (ii) Minimum Wages Act, (iii) Industrial Disputes Act, (iv) Workmen's compensation Act, (v) E.S.I Act. (Vi) Consumer protection act Important of Safety at work places, Safety Education, Hazards, causes of accidents, Cost of accidents, Fire Extinguishers, Artificial respiration, Indian Electricity rules.

4. Introduction to ISO 9000 and 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, quality control and quality assurance Elements quality systems : Management responsibility, Quality system, contract review, design control, document control, purchasing, purchaser - supplied product, product identification and traceability, process control, Inspection and testing. Principles of quality assurance - Definition of quality assurance. Indian standards on quality systems - Main features of IS 13999 : 1990, IS 14000 : 1990, IS 14004 : 1990, IS 14001: 1990, IS 14002 : 1990, IS 14003: 1990. The necessity of International standards - Evolution of ISO. 5-S principles - importance - meaning - approach - benefits Various standards under ISO - Outstanding features of ISO 9000 series of standards - ISO 9000 Phenomenon ISO 9000 series of quality systems - Constituents of ISO 9000 series of standards for quality systems. Drawbacks of ISO 9000 series of standards, list the beneficiaries of ISO 9000

REFERENCE BOOKS

1. Industrial Engineering and Management -by O.P Khanna
2. Production Management- by Buffa.
3. Engineering Economics and Management Science - by Banga & Sharma.
4. S.S.I Hand Book by S.B.P. Publishers.
5. Personnel Management by Flippo.
6. Entrepreneurship - by NITTT&R, Chennai.
7. Industrial safety management- by Deshmukh (MGH Publishers)

REFRIGERATION AND AIR CONDITIONING

Subject Title	:	Refrigeration & Air conditioning
Subject Code	:	M-602
Periods/Week	:	05
Periods per Semester	:	75

TIME SCHEDULE

Sl. No.	Major Topics	No. of Periods	Weightage	Short	Essay
1.	Fundamentals of Refrigeration & Air Refrigeration	10	13	01	01
2.	Vapour compression & Vapour absorption Refrigeration Systems	18	26	02	02
3.	Refrigerants, Refrigeration equipment & Applications	16	26	02	02
4.	Fundamentals of A/c & A/c Equipment	08	13	01	01
5.	Psychrometry, Cooling & Heating loads	14	19	03	01
6.	Applications of A/c, Servicing and maintenance of Refrigeration and A/c equipment	09	13	01	01
Total		75	110	10	08

OBJECTIVES

Upon completion of the course the student shall be able to

1.0 Understand the various methods of Refrigeration

- 1.1 Define refrigeration.
- 1.2 Explain the history of refrigeration.
- 1.3 Explain 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 Explain the principle of open air refrigeration.
- 1.8 Analyse Carnot refrigeration Cycle.

- 1.9 Analyse Bell-Coleman air-cycle.
 - 1.10 Calculate COP in above cases.
 - 1.11 Explain principle of closed air Refrigeration.
 - 1.12 Distinguish between open air system with closed air system.
- #### 2.0 Understand Vapour compression, and Vapour absorption refrigeration systems
- 2.1 Explain the importance of vapour compression system.
 - 2.2 Explain vapour compression refrigeration with the help of T-S and P-H diagrams.
 - 2.3 Distinguish between wet and dry compression.
 - 2.4 Explain the effects of under cooling and super heating 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.
 - 2.7 Explain principle of simple vapour absorption systems.
 - 2.8 List refrigerant - Absorber pairs in the above system.
 - 2.9 State the desirable properties of refrigerants absorbers.
 - 2.10 Describe the working principle of vapour absorption refrigeration system with the help of a legible sketch.
 - 2.11 Calculate "COP" of the ideal vapour absorption system.
 - 2.12 Differentiate two fluid system and three fluid absorption system.
 - 2.13 Explain working of solar powered refrigeration system with the help of a legible sketch.
 - 2.14 Explain the working of Electrolux refrigeration with the help of a legible sketch.
 - 2.15 Explain the working of Lithium Bromide absorption refrigeration system with the help of a legible sketch.
- #### 3.0 Understand the refrigerants, refrigeration equipment and applications of refrigeration
- 3.1 Distinguish between primary and secondary refrigerants.
 - 3.2 State the requirements of Refrigerants.
 - 3.3 List the properties of refrigerants.
 - 3.4 List the commonly used refrigerants.
 - 3.5 Explain different types of compressors such as reciprocating and rotary
 - 3.6 State the function of condenser and classify the condensers
 - 3.7 Explain different types of condensers such as shell & tube, shell and coil,

- fin and tube, flooded tube type with the help of a legible sketch..
- 3.8 State the function of evaporator and classify the evaporators
- 3.9 Explain various types of evaporators such as shell & tube, shell and coil, fin and tube, flooded tube type with the help of a legible sketch.
- 3.10 Explain the functions of various types of expansion devices such as capillary tube, thermostatic expansion valves and solenoid valves with the help of a legible sketch.
- 3.11 Explain the refill type and throw away type dryers.
- 3.12 Explain the working of domestic refrigerator with the help of a legible sketch.
- 3.12 Explain the working of ice Plant with the help of a legible sketch.
- 3.13 Explain the working of water cooler with the help of a legible sketch.
- 3.14 Explain the working of cold storage with the help of a legible sketch.
- 3.15 Explain the production of dry ice with the help of a legible sketch.
- 4.0 Understand fundamentals of Air conditioning and air conditioning equipment**
- 4.1 Define air conditioning
- 4.2 List modern applications of A/c.
- 4.3 Explain Air conditioning as applied to human comfort.
- 4.4 Explain the functions of fans, ducts, filters (wet, dry, electric & viscous types) C.F dust collector with the help of a legible sketches.
- 4.5 Explain the use of heating and cooling coils.
- 4.6 Explain the air distribution system.
- 5.0 Understand Psychrometry, Cooling and Heating loads.**
- 5.1 Define the terms humidity, Relative humidity, dew point, DBT & WBT, Absolute humidity, humidity ratio.
- 5.2 Explain the features of psychrometric chart.
- 5.3 Plot psychrometric processes on the above chart.
- 5.4 Explain the psychrometric patterns for heating and cooling processes.
- 5.5 Define Fundamentals of Heat transfer - Conduction, convection and Radiation.
- 5.6 Compute cooling load - components involved in cooling load.
- 5.7 Compute heating load - components involved in heating load.
(Problems on load calculations are Omitted)
- 6.0 Appreciate the applications of A/C.**
- 6.1 Explain the working of air coolers.

- 6.2 Explain the working of window air - conditioner.
- 6.3 Explain the working of cooling tower installations.
- 6.4 Explain the working of A/c systems viz., centralised and unitary systems.
- 6.5 Explain the working of summer/winter/year round air conditioners.
- 6.6 Explain the symptoms of gas shortage.
- 6.7 Explain the methods of leakage detection.
- 6.8 List the causes of common Breakdown.
- 6.9 List the remedial measures for breakdown.

COURSE CONTENT

REFRIGERATION

1.0 Fundamentals of Refrigeration and Air Refrigeration

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

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

2.0 Vapour Compression and absorption Refrigeration Systems.

Principle & analysis of vapour compression refrigeration system with the help of T-S & P-H diagrams - wet, dry and superheated compression - Refrigerating effect - Effect of pressure changes on C.O.P., effect of sub-cooling of condense on COP and capacity - effect of super heating of vapour before compression - flash chamber and accumulator.

Principle of vapour absorption refrigeration, C.O.P of vapour absorption system - Refrigerants and absorbents - their properties - two fluid & three fluid systems -solar powered refrigeration system - Electrolux refrigeration - comparison of vapour absorption and vapour compression systems.

3.0 Refrigerants, Refrigeration Equipment and applications

Primary and secondary refrigerants with examples - requirements of a refrigerant - properties of refrigerants - Commonly used refrigerants

Compressors - types of compressors. Condensers - types of condensers.

Evaporators - types of evaporators. Expansion devices - types of expansion devices - Refill type and throw away type driers.

Domestic refrigerator - ice plant, Water cooler - cold storage - production of dry ice.

AIR CONDITIONING**4.0 Fundamentals of A/c and A/c equipment**

Comfort air conditioning: Human comfort - effective temperature - Factors governing effective temperature conditions that effect body heat - comfort chart.

A/C Cycle equipment such as fans, supply ducts, outlets, return outlets and ducts, filters & dust collectors heating/cooling coil-Air distribution.

5.0 Psychrometry, Cooling and Heating

Psychrometry - Psychrometric terms - Psychrometric chart - Solving problems with psychrometric chart - Practical applications of psychrometric terms - Psychrometric processes. Psychrometric patterns for heating & cooling processes.

Conduction, convection and Radiation definitions - Heating and cooling load .

6.0 Applications of A/C, Servicing and maintenance of Refrigeration and A/c equipment

Applications of A/C: Air coolers - window air conditioner - (split & package type) - cooling towers - A/C systems: summer/winter/year round A/C, central A/C system - unitary system.

Food preservation - freeze drying.

Servicing & Maintenance of Refrigeration and A/c Equipment - trouble shooting.

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
7. Trouble shooting of Refrigeration & -by Ananthanarayana
Air conditioning

ENERGY SOURCES AND POWER PLANT ENGINEERING

Subject title : **Energy Sources and Power Plant Engineering**

Subject code : **M-603**

Periods per week : **04**

Periods per semester : **60**

TIME SCHEDULE

S. No.	Major Topics	No. of Periods	Weightage of Marks	Short Answer Questions	Essay Type Questions
1	Introduction of Renewable Sources of Energy	04	03	01	-
2	Solar and Wind Energy	12	26	02	02
3	Fuel Cells and MHD Generator	10	13	01	01
4	Bio and Tidal Energy	12	26	02	02
5	Thermal and Nuclear Power Plants	16	29	03	02
6	Environmental Pollution	06	13	01	01
	Total	60	110	10	08

OBJECTIVES

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

1.0 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

2.0 Understand the concept of solar and wind energy

- 2.1 State the amount of solar radiation reaching the earth's surface

-
- 2.2 Determine the solar constant
 - 2.3 State the principle of measuring solar radiation by pyranometer and pyrheliometer
 - 2.4 State the principle of conversion of solar radiation into heat.
 - 2.5 Explain the function of liquid flat collector
 - 2.6 Explain the working principle of solar air heater with a 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 with the help of sketch the construction details and working principle of different types of solar water heater
 - 2.15 Explain with the help of sketch the construction details and working principle of solar space heater
 - 2.16 Explain with the help of sketch the construction details and working principle of absorption refrigerator type solar space cooler
 - 2.17 Explain with the help of sketch the construction details and working principle of solar still
 - 2.18 Explain with the help of sketch the construction details and working principle of cabinet and connective type of solar drier
 - 2.19 Explain with the help of sketch the construction details and 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 Explain the conversion energy and current voltage characteristics of solar cell.
 - 2.23 State the use of photo voltaic cell for power generation
 - 2.24 Explain the solar photovoltaic arrays
 - 2.25 Explain the solar water pumping system with a sketch
 - 2.26 State the advantages and limitations of solar energy conversion.
 - 2.27 Explain the power available in the wind and force caused by it on the

-
- blades.
 - 2.28 State the collection of wind data and estimate the energy
 - 2.29 State the different considerations for sight selection for installing wind mill.
 - 2.30 Identify the basic components of a wind mill
 - 2.31 Explain the construction details on the working principle of the wind mill
 - 2.32 State the differences between horizontal axis and vertical axis type wind mills
 - 2.33 Define the terms co-efficient of performance and tip speed ratio
 - 2.34 Plot curves to indicate the variation of co - efficient of performance with tip speed ratio.
 - 2.35 Explain the method of generation of electricity by wind mill
 - 3.0 Comprehend Fuel Cells and MHD Generator**
 - 3.1 State the working principle of fuel cell
 - 3.2 Explain the construction details and working principle of Bacon's High pressure fuel cell with a legible sketch
 - 3.3 State the different types of fuels used in fuel cells
 - 3.4 Explain the working principle of aluminium air fuel cell with a legible sketch
 - 3.5 Explain the working principle of MHD Generator a legible sketch
 - 4.0 Understand Bio and Tidal Energy**
 - 4.1 Define the meaning of bio-mass and bio-gas
 - 4.2 State the principle of bio-gas generation
 - 4.3 State the chemical composition and properties of bio-gas
 - 4.4 List the applications of bio-gas
 - 4.5 List the different types of bio-gas plants
 - 4.6 Explain the construction details and working principle of fixed dome type and floating dome type bio-gas plants with sketches
 - 4.7 State the different materials used for bio-gas generation
 - 4.8 Express bio-gas plant capacity
 - 4.9 State the methods of generator control and load control
 - 4.10 Identify the energy available in tides and its usefulness in conversion
 - 4.11 State the working principle of tidal power plant
 - 4.12 State the different operation methods of utilisation of tidal energy
 - 4.13 Explain single basin and double basin arrangements

- 4.14 State the site requirements for installation of tidal power plant
- 4.15 State the advantages and limitations of tidal power generation
- 5.0 Analyse the elements of Thermal and Nuclear Power Plants**
- 5.1 Draw the layout of a thermal power plant.
- 5.2 Explain the layout of thermal power plant
- 5.3 Locate the Boiler, superheater, turbine, Electric Generator, Condenser and hot well pump in the layout.
- 5.4 Explain function of circulating water pump, Economiser, Air pre heater, Soot - Blower.
- 5.5 Explain the dust extraction in Electrostatic precipitator.
- 5.6 Explain about the ash removal, water cooling.
- 5.7 Explain about the feed water treatment.
- 5.8 Explain about the coal handling
- 5.9 Explain about the coal storage.
- 5.10 Identify the fuel handling equipment.
- 5.11 Trace the ash disposal system.
- 5.12 State the necessity of condensing the steam
- 5.13 State the principle of condensation in condenser
- 5.14 List different types of condensers
- 5.15 Explain the chain reaction
- 5.16 Explain the process of nuclear fission and nuclear fusion.
- 5.17 List nuclear fuels
- 5.18 State the characteristics of atomic power plants
- 5.19 Explain the principle of working of a nuclear reactor
- 5.20 Classify the nuclear reactors
- 5.21 Explain with the help of legible sketch the constructional details and the working principle of : (i) PWR (ii) BWR power plant.
- 5.22 Explain with the help of legible sketch the constructional details and the working principle of: (i) GCR (ii) Liquid metal - C.R. Power plant.
- 5.23 Explain about the nuclear power in India.
- 6.0 Understand the concept of environmental pollution**
- 6.1 Explain the various pollutants and their effect on the environment viz.,
- i) Particulate pollutants.
 - ii) Solid waste pollutants.

- iii) Gaseous pollutants.
- 6.2 Explain the effect of thermal pollution
- 6.3 Explain green house gases and green house effect
- 6.4 Explain the phenomena of global warming
- 6.5 Explain the effects of nuclear radiation
- 6.6 Explain the disposal of nuclear waste
- (i) Ground (ii) Air (iii) Ocean
- 6.7 Explain the following automobile norms i) Euro - IV, and ii) Bharat - IV

COURSE CONTENT

- 1.0 Introduction:** Various energy sources, Examples for energy sources, advantages and disadvantages, Need for alternate sources of energy - types of non conventional (renewable) energy sources - solar energy, wind energy, energy from bio- mass and bio-gas, tidal and wave energy, hydrogen energy, fuel cells
- 2.0 Solar and Wind Energy**
- Solar Radiation:** Solar constant - solar radiation at earth's surface - instruments for measuring solar radiation - pyranometer, pyrheliometer.
- 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.
- 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.
- Solar Energy Applications**
- i) Solar water heater - natural circulation type and forced circulation type.
 - ii) Solar space heater - passive type and active type
 - iii) Solar space cooling - absorptive refrigeration system
 - iv) Solar still, Solar drier - cabinet type and convective type and Solar cooker
- Photo voltaic conversion**
- solar cell - working principle - conversion efficiency and current voltage characteristics of a solar cell - photo voltaic cell for power

generation solar photo voltaic arrays - solar water pumping system - Advantages and disadvantages of solar energy.

Wind Energy

Introduction - power in the wind forces on the blades - wind data - energy estimation - site selection considerations - basic components of a wind mill - construction details and working principles - types of wind mill - horizontal axis type and vertical axis type - variation of co efficient of performance with tip speed ratio - electric generation by wind mill - generator control - load control.

3.0 Fuel Cells and MHD Generator

working principle - Bacon's High pressure fuel cell - construction details and working principle - types of fuels used - Aluminium - air fuel cell working principle. working principle of MHD Generator

4.0 Bio and Tidal Energy

Bio Energy - Introduction to bio - mass bio-mass conversion into energy bio-gas generation - composition and properties of bio-gas - applications of bio-gas. Classification of bio-gas plants - continuous and batch type, the dome and drum type, floating gas holder and fixed dome type - construction details and working principle of fixed dome type and floating gas holder type bio - gas plants - materials used for bio-gas generation - capacity of bio-gas plant - starting of bio-gas plant.

Tidal Energy : Introduction to tidal power - components of tidal power plants - operation methods and utilisation of tidal energy - single basin and double basin arrangements- site requirements - advantages and limitations of tidal power generation.

5.0 Steam and Nuclear Power Plant

Steam Power Plant

Layout of a Thermal Power Plant, Choice of site, explanation of important elements in layouts:- Such as Boiler, Condenser , Feed water system, Circulating water pumps ,Economiser, Air heater, Soot-Blower , Forced draught Fan, Dust collectors, Electro static precipitator

Supporting activities:- Such as Water cooling, Feed water treatment, Coal handling, Coal storage , Chimney.

Description of fuel handling equipment, unloading equipment, preparing equipment, modern ash handling equipment, dust collection and disposal , roots blower, condensers, principles classification - comparison - condensers and vacuum efficiencies and simple problems.

Nuclear - Power Plants

Nuclear energy chain reaction , nuclear materials, reactor, nuclear fission , nuclear fusion, characteristics of automatic power plants, nuclear fuels,

working principle of nuclear reactor, classification of reactors, working principle of PWR and BWR , Gas - Cooled reactor, liquid metal - cooled reactor, nuclear power in India

6.0 Environment Pollution.

Introduction - Pollutants particulate/solid/gaseous -Thermal pollution, Collection of, green house gases, green house effect, global warming. Nuclear waste disposal. Automobile norms like i) Euro - IV, and ii) Bharat - IV

REFERENCE BOOKS

1. Non conventional Energy source by G.D Rai.
2. Energy Technology by S. Rao & Dr. D.B. Palekr (Non conventional , Renewable and conventional)
3. Solar energy utilisation by G.D.Rai
4. Introduction to alternate sources of energy by TTTI, Madras
5. Solar energy by S.P. Sukhatme
6. Advances in bio-gas technology by O.P.Chawla.
8. Thermal Engineering by Arora & S. Domkundwar

CAM

Subject Title	:	Computer Aided Manufacturing
Subject Code	:	M - 604
Periods per week	:	03
Period per semester	:	45

TIME SCHEDULE

Sl No.	Major Topics	No. of periods	Weightage	Short	Essay
1.	Introduction to CAM	07	26	02	02
2.	CNC Machines and their components	10	29	03	02
3.	CNC Part Programming	12	26	02	02
4.	CIMS & Flexible Manufacturing Systems	10	16	02	01
5.	Robotics	06	13	01	01
TOTAL		45	110	10	08

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OBJECTIVES

Upon completion of the course the student shall be able to

1. Understand Computer Aided Manufacturing

- 1.1. Define CAM
- 1.2. List the functions of CAM
- 1.3. Appreciate the advantages of CAM
- 1.4. Explain the computer integrated production system
- 1.5. Explain the terms related to material requirement planning (MRP I) and Manufacturing resources planning (MRP II)

2. Understand CNC Machines and their Components

- 2.1. Define numerical control
- 2.2. Identify the components of NC & CNC systems

- 2.3. Differentiate between NC, CNC & DNC systems
 - 2.4. Explain Manufacturing Methodology on NC system
 - 2.5. Illustrate the working principle of CNC system
 - 2.6. Define Machining Centre
 - 2.7. Identify the maintenance aspects of CNC machines
 - 2.8. Appreciate the role of CNC in computer integrated manufacturing environment
 - 2.9. Identify the various spindle drives
 - 2.10. Illustrate slide ways
 - 2.11. Explain the linear motion bearings, recirculatory ball screws
 - 2.12. Appreciate the importance of automatic tool change
 - 2.13. Illustrate tool magazine
 - 2.14. Identify the various feed back devices
- 3. Understand the CNC Part Programming**
- 3.1. Explain the structure of NC part program
 - 3.2. Differentiate between manual and computer aided programming methods
 - 3.3. Explain G & M codes
 - 3.4. Explain the method of programming tool information, feed, speed data
 - 3.5. Identify the various programming cycles like thread cutting cycle etc.
 - 3.6. Write a part program in G & M codes for a simple turning job
 - 3.7. Appreciate the importance of macros, sub routines, canned cycles, mirror image
 - 3.8. Appreciate the necessity of tool nose radius compensation in programming
 - 3.9. Explain APT programming
- 4. Understand the concept of CIMS & FMS**
- 4.1. Define CIMS
 - 4.2. Appreciate the necessity of CIMS
 - 4.3. Appreciate the advantages of CIMS
 - 4.4. Identify FMS as a sub set of CIMS
 - 4.5. Identify the components of FMS
 - 4.6. Illustrate the working of FMS
 - 4.7. Identify the benefits of FMS
 - 4.8. Appreciate the importance of coordinate measuring machine.
 - 4.9. Illustrate the main features of CNC, CMM

- 4.10. List the Advantages of CNC, CMM
- 5. Understand Robotics**
- 5.1. Define a robot
- 5.2. Classify robots
- 5.3. Identify the various elements of a robot
- 5.4. Illustrate the working of a manipulator
- 5.5. Illustrate the types of end effectors
- 5.6. Identify the applications of robots
- 5.7. Appreciate the role of robots in CIMS

COURSE CONTENT

1. Computer Aided Design and Manufacturing

CAM definition. Functions of CAM. Benefits of CAM. Integrated CAD / CAM Organization concept. Computer integrated production system - features and advantages. Introductory treatment to MRP I & II

2. CNC Machines and their components

Introduction to numerical control. Features of NC system - advantages and limitations in comparison to conventional systems. Components of NC system - layout showing control unit, data input, feed back devices and machining unit. Manufacturing methodology on NC system - preparation of manuscript - programming - input to control unit - manufacturing. Development of CNC and DNC systems - comparative treatment of features for NC, CNC, DNC. Block diagram of CNC system and functions of each component. Working principle of CNC system - advantages over NC system.

Types of turning centers - machining centers - horizontal, vertical.

Specifications of CNC machines. Care and maintenance of CNC machines. Spindle drives - DC drive - AC drive and linear induction motors. Slide ways - types with illustrations. Bearings - linear motion bearings - recirculatory ball screws. Automatic tool change - working of tool magazine. Feedback devices - encoders - linear transducers'

3. CNC Part programming

CNC program procedure - coordinate system - reference points - zero points. Preparatory and miscellaneous functions (G & M codes). Methods of part programming - manual and APT programming. Tool information - speed - feed data. Interpolation - linear and circular. Macros - subroutines - canned cycles - mirror image - thread cutting cycles. Programming

Practice problems on turning jobs

4. CIMS & FMS

Computer integrated manufacturing system - definition - features - necessity. Flexible manufacturing system - definition - features - necessity. Components of FMS - functions of each component - illustration. Advantages and limitations of FMS. Coordinate measuring machine - Introduction, CMM and CNC CMM - main features of CNC CMM - Scanning - Digitization - Advantages.

5. Robotics

Definition of robot - classification - features - necessity. Components of robot - illustration - functions of each component. Manipulator - illustration - degrees of freedom. End effectors - types with illustration - necessity and application. Industrial application of robots - advantages and limitations. Artificial intelligence - introductory treatment only.

REFERENCE BOOKS

1. Computer Integrated Design And Manufacturing, McGraw Hill-Bedworth David. D
2. Computer Integrated Manufacturing, PHI - Paul G. Ranky
3. Industrial Robotics, PHI - Gordon. N. Mair
4. Numerical Control And Computer Aided Manufacturing - T.K.Kundra,P.N.Rao(TMH)
5. Computer Aided Manufacturing,-T. K. Kundra, P.N. Rao (MGH Publishers)
6. CNC Machines, New Age-B.S. Pabla and M. Adithan

MEASUREMENT & CONTROL SYSTEMS

Subject Title : Measurement & Control Systems
Subject Code : M - 605
Periods per week : 05
Period per semester : 75

TIME SCHEDULE

SI No.	Major Topics	No. of periods	Weightage of marks	Short Answer Questions	Essay Type Questions
1.	Measuring Instruments & their Characteristics	12	16	02	01
2.	Measurement errors	06	13	01	01
3.	Transducers	20	26	02	02
4.	Measurement of Angular Speed, Temperature, Pressure and Flow	25	39	03	03
5.	Control Systems	12	16	02	01
	TOTAL	75	110	10	08

OBJECTIVES

Upon completion of the course the student shall be able to

- 1. Understand the Measurement systems & their characteristics**
 - 1.1 Define Measurement
 - 1.2 Explain the Significance of measurement
 - 1.3 Methods of Measurements-
Explain
 - a. Direct and Indirect
 - b. Primary, Secondary and Tertiary
 - c. Contact and Non-contact
 - 1.4 Classify Instruments
 - 1.5 List the Instruments and Measuring Systems-Its Functions

- 1.6 List the Applications of measurement systems
- 1.7 List the Instrument characteristics (Static & Dynamic)**

Explain Static Characteristics

- 1.7.1 Scale range and scale span
- 1.7.2 Scale readability
- 1.7.3 Repeatability and reproducibility
- 1.7.4 Drift
- 1.7.5 Noise- signal to noise ratio- sources of noise
- 1.7.6 Accuracy and precision
- 1.7.7 Static sensitivity
- 1.7.8 Linearity
- 1.7.9 Hysteresis
- 1.7.10 Threshold
- 1.7.11 Dead time and dead zone
- 1.7.12 Resolution or discrimination

Explain Dynamic Characteristics

- 1.7.13 Speed of response and measuring lag
- 1.7.14 Fidelity and dynamic error
- 1.7.15 Overshoot

2. Understand the Measurement Errors

- 2.1 Explain the scope of Errors
- 2.2 Classify errors and explain
 - 2.2.1 Instrument errors
 - 2.2.2 Environmental errors
 - 2.2.3 Translation and signal transmission errors
 - 2.2.4 Observation errors
 - 2.2.5 Operational errors
 - 2.2.6 System interaction errors
- 2.3 Factors to be considered for selecting an instrument

3. Understand the Transducers

- 3.1 Define Transducer
- 3.2 Explain Mechanical detector-transducer elements
 - 3.2.1 Elastic elements

- 3.2.2 Mass sensing elements
- 3.2.3 Thermal detectors
- 3.2.4 Hydro-pneumatic elements
- 3.3 Classify Transducers
 - Explain
 - 3.3.1 on the basis of transduction form used,
 - 3.3.2 Primary and secondary transducers
 - 3.3.3 Passive and active transducers
 - 3.3.4 Analog and digital transducers
- 3.4 Explain Resistive transducer, piezo electric transducer, capacitive transducer
- 3.5 Define Strain gauges
 - 3.5.1 List the requirements of strain gauge
 - 3.5.2 Explain the types of strain gauges
 - 3.5.3 Explain unbounded metal strain gauges
 - 3.5.4 Explain Bonded metal wire strain gauges
 - 3.5.5 Explain Bonded metal foil strain gauges
 - 3.5.6 Explain Bonded semiconductor strain gauges
- 3.6 Explain Rosettes
- 4. Understand the Measurement of Angular Speed, Temperature, Pressure and Flow**
 - Measurement of angular speed**
 - 4.1 List the types of Tachometers
 - 4.2 Explain the working principle of following Tachometers with a legible sketch
 - 4.2.1 Mechanical Tachometers-Revolution counter and timer, slipping Clutch Tachometer
 - 4.2.2 Electrical Tachometers- Drag cup tachometer, and Tachogenerator
 - 4.2.3 Contactless Electrical Tachometer-Inductive pickup, and Capacitive, pickup tachometer
 - Measurement of Temperature**
 - 4.3 List the types of Thermometers
 - 4.3.1 Explain Liquid in glass thermometer
 - 4.3.2 Explain Bimetallic thermometer
 - 4.3.3 Explain Thermocouples

- 4.3.4 Explain Thermistor
- 4.3.5 Explain Pyrometers-Radiation and Optical
- Measurement of Pressure**
- 4.4 List the Types of pressure measurement devices
 - 4.4.1 Explain Bourdon tube pressure gauge
- Measurement of Flow**
- 4.5 List the Types of Flow meters
 - 4.5.1 Explain Rota meters
 - 4.5.2 Explain hot wire anemometer (constant temp and constant Current)
 - 4.5.3 Explain Ultrasonic flow meter
- 5. Understand the Control Systems**
- 5.1 Explain the Concept of a control system
- 5.2 List the Elements of Control Systems
- 5.3 Classify control systems-
- 5.4 Explain the following with legible sketch
 - 5.4.1 Open loop and Closed loop systems
 - 5.4.2 Servo mechanisms
 - 5.4.3 Rotational system
 - 5.4.4 Electrical systems
 - 5.4.5 Analog systems
 - 5.4.6 Pneumatic controller
 - 5.4.7 Pneumatic relay, Pneumatic Actuator
 - 5.4.8 Hydraulic control systems
- 5.5 List the Applications of Pneumatic control systems

COURSE CONTENT

- 1. Measurement systems & their characteristics**
Definition of Measurement, Significance, Methods of Measurements, Classification of Instruments, Instruments and Measuring Systems-Its functions, Applications of measurement systems, Instrument characteristics (Static & Dynamic)
- 2. Measurement of Errors**
Classification of errors- Instrument errors, Environmental errors,

Translation and signal transmission errors, Observation errors, Operational errors, System interaction errors, Factors to be considered for selecting an instrument

3. Transducers

Mechanical detector-transducer elements, Transducer-Classification of Transducers, Resistive transducer, piezo electric transducer, capacitive transducer, Strain gauges -requirements of strain gauge-types, Rosettes

4. Measurement of Angular Speed, Temperature ,pressure and Flow

Measurement of angular speed-Tachometers, Mechanical Tachometers-Electrical Tachometers-Contactless Electrical Tachometer Measurement of Temperature-Thermometer, Liquid in glass thermometer, Bimetallic thermometer, Thermocouples, Thermistor, Pyrometers-Radiation and Optical Measurement of Pressure-Types , Bourdon tube pressure gauge Measurement of Flow- Rotameters, Hot wire anemometer(constant temp and constant current) and Ultrasonic flow meter

5. Control Systems

What is a control system- Classification, Open loop and Closed loop systems-Servo mechanisms-Rotational systems- Electrical systems-Analog systems-Pneumatic controller-Pneumatic relay- Pneumatic Actuator-Hydraulic control systems

Elements of Control Systems

Applications of Pneumatic control systems

REFERENCE BOOKS

1. Mechanical Measurements and Instrumentation & Control - A.K.Sawhney Puneet Sawhney (Dhanpat Rai & Co)
2. Mechanical Measurements & Control-Dr.D.S.Kumar (Metropolitan book co.Pvt.Ltd)
3. Mechanical Measurements & Control-- R.V.Jalgaonkar
4. Instrumentation Devices & Systems -- C.S.Narang
5. Mechanical & Industrial Measurements -- R.K.Jain
6. Instrumentation,Measurement and Analysis -- B.C.Nakra and Chaudhry

AUTOMOBILE ENGINEERING

Subject Title	: Automobile Engineering
Subject code	: M-606
No. of periods per week	: 04
Periods per semester	: 60

TIME SCHEDULE

S.No	Major Topics	Number of Periods	Weightage of Marks	Short Answer Questions	Essay Type Questions
1	Introduction & Chassis Construction	10	16	2	1
2	Transmission & Clutches	16	32	4	2
3	Propeller shaft and rear axle	10	18	1	1 ½
4	Suspension system	06	13	1	1
5	Front axle and steering	12	18	1	1 ½
6	Brakes	06	13	1	1
	Total	60	110	10	08

OBJECTIVES

Upon completion of the course the student shall be able to

1.0 Understand the concept of automobile

- 1.1 List the various components of an automobile.
- 1.2 Explain the function of basic structure, power plant, transmission system, auxiliaries, controls of the automobiles.
- 1.3 List the various types of Chassis construction.
- 1.4 Explain conventional Chassis construction with a legible sketch
- 1.5 Explain Frame construction.
- 1.6 List the materials for frame

- 1.7 List the Defects in Frames.
- 1.8 Explain the frameless construction.
- 2.0 Understand the Transmission & Working principle of Clutches**
- 2.1 Define the term Transmission.
- 2.2 State the Functions of transmission system.
- 2.3 Explain the Concept of total resistance to the vehicle motion - tractive effort- Necessity of transmission.
- 2.4 List the Types of gear boxes.
- 2.5 Explain the Selector Mechanism with legible sketch
- 2.6 Explain the Lubrication of gear box.
- 2.7 State the requirements for the effective functioning of Clutch.
- 2.8 List the Components of clutch.
- 2.9 Explain Mechanical operation of clutch.
- 2.10 List the main types of clutches.
- 2.11 State the Principle of friction clutches.
- 2.12 List the Different types of dry friction clutches.
- 2.13 Explain the Hydraulically operated (Fluid type) clutch with legible sketch
- 3.0 Understand the function of Propeller Shaft and rear axle**
- 3.1 State the functions of propeller shaft.
- 3.2 Explain construction of propeller shaft.
- 3.3 Know about various universal joints in automobile
- 3.4 Functions and operation of a differential in an automobile.
- 3.5 Sketch general arrangement of a live rear axle
- 3.6 Identify loads on rear axle.
- 3.7 Identify different methods of supporting rear axle.
- 3.8 Distinguish between semi-Floating and fully floating rear axle.
- 4.0 Understand the working of Suspension System**
- 4.1 List the Objectives of vehicle suspension.
- 4.2 List the various factors considered for suspension
- 4.3 List the different types of suspension springs
- 4.4 Explain the Construction details of leaf spring and its mounting on front and rear axles with legible sketch.
- 4.5 List the Different types of rubber springs.
- 4.6 Explain air suspension system with legible sketch.

- 4.7 Explain the principle of shock absorber.
- 4.8 Explain the construction details and working of a telescopic type of shock absorber with legible sketch.
- 5.0 Understand the function of Front Axle and Steering**
- 5.1 Define the terms Front Axle and Steering.
- 5.2 Define Stub Axle type.
- 5.3 Explain the Front wheel assembly
- 5.4 List the Factors of wheel alignment.
- 5.5 Explain the Balance of wheels-Inflation of tyres- Brake Adjustment.
- 5.6 Explain the Steering geometry
- 5.7 List Steering linkages.
- 5.8 Write correct steering angle.
- 5.9 Explain the Steering mechanism with legible sketch
- 5.10 Explain cornering force - Self righting torque.
- 5.10 Explain under steering - over steering.
- 5.11 Write the Principle of power steering.
- 6.0 Understand the function of Brakes**
- 6.1 List the requirements of automobile brake.
- 6.2 Explain the transfer of weight during braking operation.
- 6.3 Explain the wheel skidding and techniques to prevent wheel Skidding.
- 6.4 Various factors influencing braking effect.
- 6.5 Classify the brakes.
- 6.6 Describe the mechanical shoe brake with legible sketch.
- 6.7 Draw a simple diagram to show the layout of a hydraulically operated four wheel brake system and explain its working in detail.
- 6.8 Draw a schematic diagram showing the layout of complete air pressure system of brakes and explain the working of its main units in detail.

COURSE CONTENT

- 1.0 Introduction & Chassis construction**
- 1.1 Identify the various components of an automobile.
- 1.2 The basic structure, the power plant, transmission System, the auxiliaries the controls and the superstructure of an automobile.

- 1.3 Different types of Chassis construction.
- 1.4 The functions of the Frame.
- 1.5 The loads on the frame,
- 1.6 Frame construction with a neat sketch.
- 1.7 Identification of various materials for frame.
- 1.8 Sub frames and defects in frames.
- 1.9 Frameless construction with a sketch.
- 2.0 Transmission and Clutches**
- 2.1 Introduction and Functions of transmission system
- 2.2 Concept of total resistance to the vehicle motion - Tractive effort - necessity of transmission.
- 2.3 Working of Sliding mesh - Constant mesh - Synchromesh gear boxes.
- 2.4 Working of selector mechanism with gear lever on top of transmission case.
- 2.5 Lubrication of gear box.
- 2.6 Functions of clutches.
- 2.7 Requirements of Clutch.
- 2.8 Brief description of Components of clutch, clutch plate- clutch facing - pressure plate - Springs - Bearings.
- 2.9 Mechanical operation of clutch.
- 2.10 Main types of clutches (friction clutch and fluid clutch only)
- 2.11 Principle of friction clutches - coefficient of friction (μ), Axial Pressure (w) and mean radius of contact surfaces(R)
- 2.12 Description and working of dry friction clutches-Single plate multi plate.
- 2.13 Working of Hydraulically operated single plate clutch.
- 3.0 Propeller Shaft and rear axle**
- 3.1 The functions of propeller shaft.
- 3.2 The construction of propeller shaft with a neat sketch.
- 3.3 Various universal joints in automobiles.
- 3.4 The function and operation of differential in an automobile.
- 3.5 The general arrangement of a live rear axle.
- 3.6 Different loads on rear axle.
- 3.7 Different methods of supporting rear axle shafts with sketch.
- 3.8 The difference between semi-floating and fully floating rear axle.

- 4.0 Suspension System**
- 4.1 The objectives of vehicle suspension
- 4.2 The factors to be considered for suspension system.
- 4.3 Different types of suspension springs.
- 4.4 The construction of leaf spring and how it is mounted on rear and front axles with neat sketch.
- 4.5 Different types of rubber springs.
- 4.6 The action of air springs
- 4.7 The schematic diagram showing the layout of an air suspension system and describe its working
- 4.8 The principle, construction and working of a telescope type of shock absorber.
- 5.0 Front Axle and Steering**
- 5.1 Introduction to front axle.
- 5.2 Stub axle connection- ELLIOT - Reversed ELLIOT - LAMOINE - Reversed LAMOINE - brief Description.
- 5.3 Description of front wheel stub axle assembly.
- 5.4 Factors influencing of wheel alignment .
- 5.5 Factors pertaining to wheels - Balance of Wheels - Inflation of tyres - Brake adjustment-Concept of Steering Geometry - Camber - Kingpin Inclination - combined angle - castor - Toe-in & Toe-out.
- 5.6 Steering linkage - principle of correct steering angle (without mathematical analysis) simple equation
- 5.7 Details of Ackerman steering mechanism.
- 5.8 Concept of cornering force-self righting torque.
- 5.9 Concept of under steering & over steering.
- 6.0 Brakes**
- 6.1 The requirements of a automobile brake.
- 6.2 The transfer of weight during braking operation.
- 6.3 The wheel skidding and describe techniques to prevent wheel Skidding.
- 6.4 Various factors influencing braking effect.
- 6.5 Classification of brakes.
- 6.6 The mechanical shoe brake with a neat sketch.
- 6.7 The layout of a hydraulically operated four wheel brake system with a simple diagram and explain its working in detail.

6.8 The schematic diagram showing the layout of complete air brake system and explain the working of its main units in detail.

REFERENCE BOOKS

- | | | |
|---------------------------|---|------------------------|
| 1. The motor vehicle | - | Newton steeds & Garret |
| 2. Automotive Chassis | - | P.M. Heldt. |
| 3. Mechanism of the car | - | A.W. Judge |
| 4. Automotive mechanism | - | Joseph Heitner. |
| 5. Automotive Engineering | - | G.B.S. Narang |

CAM LAB PRACTICE

Subject Title	:	CAM Lab Practice
Subject Code	:	M-607
Periods per week	:	04
Periods per semester	:	60

OBJECTIVES

Upon completion of the course the student shall be able to

1. Identify the parts and functions of CNC lathe
2. Use incremental system and absolute system on dimensioning.
3. Write simple part program using G-Codes and M-Codes.
4. Edit and execute a part program using CNC lathe machine simulation package.
5. Prepare part program as per the drawing.
6. Produce part as per the drawing using CNC lathe machine.

COURSE CONTENT

1. CNC Introduction
2. Study of turning.
3. G - codes and M- codes
4. Simulation software practice.
5. Structure of program.
6. Turning exercise - step turning using canned cycle.
7. Turning exercise - circuits interpolation CW, CCW.
8. Turning Exercise - Taper turning and Peck drilling.
9. Turning exercise - Thread cutting and grooving.

Note: The simulation software available in the market:
FANUC, SIEMENS, HI NUMERIC, GSK etc.,

Key competencies to be achieved by the student

Exercise	Key competencies expected
1.Hands on practice on CNC machine	A. Identify the various parts and switches B. Operate the various parts and knobs of the machine - Switch on / off
2.Practice turning Operation on CNC machine	A. Use incremental system and absolute system of co-ordinate system B. Use appropriate tools for turning C. Select the speeds and feeds used for turning D. Select the depth of cut to be employed
3.Use G-Codes and M-Codes to write part program	A. Identify the preparatory and miscellaneous functions of CNC B. Understand the meanings of various G-Codes and M-Codes C. Identify frequently used G-Codes and M-Codes
4.Practice with Simulation software	A. Understand the concept of simulation B. Practice the setting of software in simulation mode C. Open an existing part program D. Practice simulation for the program
5.Read the Structure of program	A. Understand the block numbers B. Understand various steps in the program
6.Practice step turning canned cycle (Turning exercise)	A. Understand the canned cycle B. Write a part program to produce the part as per the given drawing C. Enter the program in the software D. Fix the job and set the tool E. Select proper cutting speed, depth of cut and feed for the given job F. Simulate the program and edit if necessary G. Execute the part program
7.Practice Turning exercise circuits interpolation CW, CCW	A. Understand interpolation B. Use the codes for interpolation in part program C. Write and enter the program in the system D. Simulate and execute the program
Practice Turning exercise – Taper turning and Peck drilling	A. Select proper values of cutting speeds and feeds for taper turning and peck drilling B. Write part program for taper turning and peck drilling as per the given drawing C. Select suitable cutting tools for the two operations separately D. Fix the tools in the turret E. Fix the job F. Simulate and edit the part program if necessary G. Execute the part program
Practice Turning exercise – Thread cutting and grooving	A. Select proper values of cutting speeds and feeds for Thread cutting and grooving B. Write part program for Thread cutting and grooving as per the given drawing C. Select suitable cutting tools for the two operations separately D. Fix the tools in the turret E. Fix the job F. Simulate and edit the program if necessary G. Execute the part program

**THERMAL ENGINEERING & REFRIGERATION AND AIR CONDITIONING
LABORATORY PRACTICE**

Subject Title	:	Thermal Engineering & Refrigeration and Air Conditioning Lab Practice
Subject Code	:	M - 608
Periods per Week	:	03
Periods per Semester	:	45

TIME SCHEDULE

S.No	Name	Number of Periods
1	Economic Speed Test	03
2	Water Cooling Curves	03
3	Morse Test	03
4	Performance Curves	03
5	Heat Balance Sheet	03
6	Mercet Boiler	03
7	Familiarisation with R&AC Tools and Basic Operations on soft Copper tube	03
8	C O P of Vapour Compression cycle test rig	03
9	C O P of Domestic refrigerator or water cooler	03
10	Leak detection of refrigeration equipment	03
11	C.O.P. of A.C. system	03
12	Vaccumisation and Charging of compressor	03
13	Study of different types of wind mills and wind measuring instruments	03
14	Study of solar appliances(Heaters, stills, Driers etc.,)	06
Total		45

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

1. **Understand the importance of economic speed of given S.I. / C.I. engine**
 - 1.1 Identify the type of engine and its parts
 - 1.2 Circulate cooling water through the engine jacket before starting the engine and after shutting the engine
 - 1.3 Crank the engine and operating decompression lever
 - 1.4 Maintain constant load
 - 1.5 Vary the fuel supply by operating the lever
 - 1.6 Record the corresponding readings of fuel consumption and speed

- 2. Appreciate the importance of drawing water cooling curves on IC engines**
 - 2.1 Identify the type of engine and its parts
 - 2.2 Circulate cooling water through the engine jacket before starting the engine and after shutting the engine
 - 2.3 Crank the engine and operating decompression lever
 - 2.4 Maintain constant load and speed
 - 2.5 Control flow rate of cooling water into the engine
 - 2.6 Record the readings of cooling water temperatures at inlet and outlet.
 - 2.7 Record the fuel consumption rate by using stop watch
- 3. Understand the importance of Morse test on multi-cylinder petrol / diesel engine**
 - 3.1 Identify the type of engine
 - 3.2 Circulate cooling water through the engine jacket before starting the engine and after shutting the engine
 - 3.3 Crank the engine and operating decompression lever
 - 3.4 Vary the load
 - 3.5 Maintain constant speed
 - 3.6 Disconnect engine cylinders one by one by operating the lever
 - 3.7 Record the readings in spring balance without parallax error
- 4. Understand the importance of performance characteristics of given IC engine**
 - 4.1 Identify the type of engine and its parts
 - 4.2 Circulate cooling water through the engine jacket before starting the engine and after shutting the engine
 - 4.3 Crank the engine and operating decompression lever
 - 4.4 Vary the load
 - 4.5 Record the load
 - 4.6 Record the speed by using tachometer
 - 4.7 Handle the stop watch for measuring time for 10c.c consumption of fuel
 - 4.8 Draw the graphs (B.P. Vs R.P.M., B.S.F.C. Vs R.P.M., B.M.E.P. Vs R.P.M., Mechanical Efficiency Vs R.P.M.,)
- 5. Understand the importance of heat balance of given IC engine**
 - 5.1 Identify the type of engine and its parts
 - 5.2 Circulate cooling water through the engine jacket before starting the engine and after shutting the engine

- 5.3 Crank the engine and operating decompression lever
- 5.4 Adjust the load
- 5.5 Identify the cooling water inlet and outlet
- 5.6 Record the reading of cooling water temperature at inlet and outlet
- 5.7 Record time taken for 10c.c fuel consumption
- 5.8 Record exhaust gas temperature
- 5.9 Calculate on of quantity of heat liberated by the fuel and the heat equivalent of brake power, heat carried away the jacket cooling water and heat carried away by the exhaust gases.
- 6. Appreciate the pressure Vs temperature relationship of saturated steam using Mercet Boiler**
 - 6.1 Identify type of boiler and various parts of it.
 - 6.2 Heat the water filled in boiler drum by using Bunsen burner
 - 6.3 Identify the formation of saturated steam
 - 6.4 Record the readings of pressure and temperature
 - 6.5 Draw the graph between Pressure Vs Temperature.
- 7. Perform basic fabrication operations viz., flaring, swaging, bending and brazing on soft copper tubes**
 - 7.1 Use the tools to perform flaring, swaging, bending and brazing operations
- 8. Evaluate the C.O.P of a given Vapour Compression cycle test rig**
 - 8.1 Identify the components of vapour compression system
 - 8.2 Record the values of pressure and temperature when the pressure gauges are stabilized
 - 8.3 Record the energy meter reading
 - 8.4 Read the values from Pressure Vs Enthalpy diagram of the given refrigerant
 - 8.5 Evaluate C.O.P
- 9. Evaluate the C.O.P of a Domestic Refrigerator or water cooler**
 - 9.1 Identify the components
 - 9.2 Record the values of pressure and temperature when the Pressure gauges are stabilized
 - 9.3 Record the energy meter reading
 - 9.4 Read the enthalpy values from Pressure Vs Enthalpy diagram of the given refrigerant
 - 9.5 Evaluate C.O.P
- 10. Identify various types leak detection methods of a refrigeration system**

- 10.1 Detect the leakages of given vapour compression refrigeration system by using soap solution method.
- 10.2 Apply the methods of arresting leakages
- 10.3 Arrest the leakages if any by soldering
- 11. Evaluate the C.O.P. of given air-conditioning system**
- 11.1 Identify the components of given vapour compression air-conditioning test rig.
- 11.2 Insert thermometers in suction line and discharge line
- 11.3 Run the given V.C. A.C. system for some time
- 11.4 Record the pressure and temperature readings when the pressure gauges are stabilized.
- 11.5 Record the energy meter reading
- 11.6 Read the enthalpy values from Pressure Vs Enthalpy diagram of the given refrigerant
- 11.7 Evaluate c.o.p
- 12. Apply the method of vaccumization and refrigerant charging for a given vapour compression system.**
- 12.1 Evacuate the given V.C.R. system using a vacuum pump
- 12.2 Charge the given V.C.R. system by using suitable refrigerant gas
- 12.3 Run the system for at least 15 min. and check for the build up of pressure in the pressure gauge.
- 13. Study of different types of wind mills and wind measuring instruments**
- 14. Study of solar appliances(Heaters, stills, Driers etc.,)**

S.No	Exercise	Key competency
1	Economic speed Test	<ul style="list-style-type: none"> a. Circulate cooling water through the engine jacket before starting the engine and after shutting the engine b. Maintain a constant load c. Vary the fuel supply by operating the lever d. Record the corresponding readings of fuel consumption and speed
2	Water cooling curves	<ul style="list-style-type: none"> a. Maintain constant load and speed b. Record load and speed c. Control flow rate of cooling water into the engine d. Record the readings of cooling water temperatures at inlet and outlet. e. Record the fuel consumption rate by using stop watch f. Draw graphs (s.f.c. Vs exit temperature of cooling water)
3	Morse test on multi-cylinder diesel / petrol engine	<ul style="list-style-type: none"> a. Vary the load b. Maintain constant speed c. Disconnect engine cylinders one by one by operating the lever d. Record the readings in spring balance without parallax error
4	Performance curves	<ul style="list-style-type: none"> a. Vary the load b. Record the load c. Record the speed by using tachometer d. Handle the stop watch for measuring time for 10c.c consumption of fuel e. Draw the graphs (B.P. Vs R.P.M., B.S.F.C. Vs R.P.M., B.M.E.P. Vs R.P.M., Mechanical Efficiency Vs R.P.M.,)
5	Heat balance sheet	<ul style="list-style-type: none"> a. Allow cooling water to enter the cylinder jacket. b. Adjust the load c. Record the load and speed d. Record the reading of cooling water temperature at inlet and outlet e. Record time taken for 10c.c fuel consumption f. Record exhaust gas temperature
6	Mercet boiler	<ul style="list-style-type: none"> a. Record the readings of pressure and temperature b. Draw the graph between pressure Vs temperature.
7	Basic fabrication operations on soft copper tube	<ul style="list-style-type: none"> a. Use the tools to perform flaring, swaging, bending and brazing operations

S.No	Exercise	Key competency
8	C O P of Vapour Compression cycle test rig.	a. Record the values of pressure and temperature when the pressure gauges are stabilized b. Record the energy meter reading c. Read the values from Pressure Vs Enthalpy diagram of the given refrigerant d. Evaluate C.O.P
9	C.O.P. of domestic refrigerator or t water cooler	a. Record the values of pressure and temperature when the pressure gauges are stabilized b. Record the energy meter reading c. Read the enthalpy values from Pressure Vs Enthalpy diagram of the given refrigerant d. Evaluate C.O.P
10	Leak detection of refrigeration equipment	a. Apply soap solution over suction lines, discharge lines and various joints b. Detect the leaks by observing the air bubbles c. Arrest the leaks if any by using soldering
11	Evaluate C.O.P. of A.C. system	a. Run the given V.C. A.C. system for some time b. Record the pressure and temperature readings when the pressure gauges are stabilized. c. Record the energy meter reading d. Read the enthalpy values from Pressure Vs Enthalpy diagram of the given refrigerant e. Evaluate C.O.P
12	Vacuumization and charging of refrigeration system	a. Detect the leaks in the given refrigeration system b. Arrest the leaks if any c. Evacuate the system by using a vacuum pump d. Charge the system by suitable refrigerant gas e. Run the system for some time and check for the build up of pressure by observing the pressure gauge reading.
13	Study of different types of wind mills and wind measuring instruments	a. Draw the line diagram of Wind mill b. Identify the constructional details of Wind mill and Wind speed measuring instruments c. Identify the various material used for Wind mill components d. Estimate the performance of wind mill
14	Study of solar appliances(Heaters, stills, Driers etc.,)	a. Draw the line diagram of Solar appliances b. Identify the constructional details of Solar appliances c. Identify the various material used for Solar appliances d. Estimate the performance Solar appliances of wind mill

MANUFACTURING /SERVICING AND MAINTANANCE LAB PRACTICE

Subject Title : **Manufacturing /Servicing and Maintenance Lab Practice**

Subject Code : **M-609**

Periods per week : **03**

Periods per semester : **45**

OBJECTIVES

Upon completion of the course the student shall be able to

A. Understand various operations in machine shop

1. Practice the cutting operation on slotter
2. Practice the cutting operation on planer
3. Practice the principle of indexing on milling machine.
4. Perform Cutting operation on milling machine
5. Perform Cutting operation on V-block on shaping machine.

B. Understand various operations in Welding

1. Produce utility articles such as shoe rack, garden chair, wash basins, stools etc

C. Understand various operations in Foundry

1. Prepare a mould for flange coupling.
2. Understand the operation of cupola and pit furnace.
3. Prepare a metal casting of simple objects in Aluminium.

D. Understand various activities in servicing and maintenance

1. Use the servicing methods of IC-Engine parts.
2. Overhaul petrol and diesel Engines.
3. Locate faults and rectify the same.
4. Select Appropriate recovery methods for a given machine elements and Performing recovery processes by using appropriate methods such as Arc/gas welding, metal spraying, applying adhesives etc.,
5. Use the servicing methods of sewing machine, pumps
6. Use the testing and inspection methods of machine tools.
7. Dismantle and assemble machine tools.

8. Recondition the parts.
9. Service and overhaul machine of general nature.
10. Service and overhaul pneumatic power tools (Air impact wrench, Air ratchet, Air brush, Blow gun, Pneumatic drill, Jack, nail gun, Sand blaster, paint sprayer)
10. Prepare maintenance schedules and estimates.

COURSE CONTENT

A. Machine Shop

1. V-Block, 2. Gear Cutting on Milling Machine, 3. Splines on Slotting Machines, 4. Practice on Planning machines, 5. Key way cutting, 6. Various Milling operations, 7. T-slot cutting on milling machine

B. Welding

1. Shoe Rack 2. Garden Chair. 3. Stools 4. Pot Stands etc.,

C. Foundry

1. Solid bearing 2. Flange coupling 3. Operation of cupola 4. Metal casting and fettling.

D. Service and Maintenance

Carburetor, Injectors, Piston Assembly, Gear Box, Clutch, Valve Assembly, Propeller Shaft and Universal Joint, Differential, Axles etc.,

Sub - assembly of small components such as, Tail stock, checks of lathes, 3-jaw chuck, 4-jaw chuck. Measurement of wear on M/c elements such as, lathe beds, guide ways & shapers. Selection of appropriate recovery methods for a given M/c element and performing recovery processes by using appropriate methods such as: Arc/Gas Welding, Metal spraying, Applying adhesives etc. Fault finding and repairs of equipment such as machine tools, washing machines. Maintenance of various machine tools & engines including preparation of preventive maintenance schedule of a typical workshops .

Key competencies to be achieved by the student

S.No	Exercise	Key competencies expected
1.	Key way cutting by slotting machine	A. Fix the job on slotting machine table B. Set the tool and give the table feed C. Set the stroke of the ram
2.	Indexing on slotting / milling machine	A. Identify of suitable indexing method B. Calculate revolutions of indexing crank C. Select index plate D. Select of hole circle
3.	T-slot cutting on milling machine	A. Identify T-slot cutter B. Exact setting of work-tool location
4.	Bevel / Helical gear cutting on milling machine	A. Calculate no. of teeth on meshing gears for compound indexing B. Identify suitable HOB C. Select suitable holder for bevel gear blank
5	Servicing of Carburetor, Injectors, Piston, assembly, Gear Box, Clutch, Valve Assembly, Propeller Shaft and Universal Joint, Differential, Axles etc.,	A. Select suitable dismantling/assembly tools. B. Identify the problem C. Rectify the defect D. Select suitable lubricant. E. Locate lubricating points.
6	Assembly of small components such as, Tail stock, chucks of Lathes, 3-jaw chuck, 4-jaw chuck.	A. Select suitable dismantling/assembly tools. B. Identify the problem C. Rectify the defect D. Select suitable lubricant. E. Locate lubricating points.

PROJECT WORK

Subject Title	:	Project work
Subject Code	:	M-610
Periods per week	:	07
Period's semester	:	105

OBJECTIVES

Upon completion of the course the student shall be able to

1.0 Prepare technical project report

- 1.1 Identify component with mechanical bias.
- 1.2 Design and draw the production drawings.
- 1.3 Prepare a project report with details of materials, processes etc.
- 1.4 Develop a proto type/model of the product with the facilities available in polytechnic.

2.0 Conduct survey to establish a small scale unit

- 2.1 Identify and select a product with an aim to set up a small scale industry.
 - 2.2 Conduct a detailed market survey.
 - 2.3 List the raw materials, equipment and tools needed for the manufacture of a specified quantity.
 - 2.4 Explore the various financial arrangements to start the manufacture of a product under technocrat scheme in small scale industrial sector.
 - 2.5 Make a survey of requirements of the department of industries, municipal, health, inspectorate of factories for starting an industry.
 - 2.6 Plan for a type of organisation.
 - 2.7 Select a site.
 - 2.8 Prepare a techno feasibility report consisting of drawings, plant layouts, building requirements, machinery and equipment requirements, raw material, labour, production and administrative staff requirements, working capital, material flow sheet, cash flow sheet, financial analysis etc.
- 3.0 Develop working models to show scientific and engineering principles studied in the curriculum and repair, up gradation and maintenance of equipment which are exist.

COURSE CONTENT

The following activities are envisaged in this course of study

1. Identification and selection of a product with an aim to set small scale

industry.

2. Conduct of detailed market survey.
3. Preparation of production drawings.
4. List of the raw materials, equipment and tools needed for manufacturing a specified quantity.
5. Development of a prototype model of the product in workshop (if possible) with the available facilities in the Polytechnics.
6. Exploration of the various financial arrangements to start the manufacturing of the product under technocrat scheme in small scale industrial sector.
7. Detailed survey of requirements of the department of industry, municipal, health inspectorate of factories, electrical inspectorate, banks, other financial agencies etc., for starting an industry.
8. Planning for type of organisation.
9. Selection of site.
10. Preparation of techno feasibility report consisting of production drawings, plant layout, building requirements, equipment requirement, list of raw materials and their availability, tools and other items, labour force production, ministerial staff requirement, material flow sheet, cash flow sheet, financial analysis etc.
11. Working models, repairs up gradation maintenance of equipment.

Note: Product selection may be done by the Polytechnic in consultation with the local industries and other agencies.

The student should submit techno feasibility report on a product selected with an aim to set up an industry in small scale sector.

Key competencies to be achieved by the student

Project work	Key competencies expected
Technical project report	A. Select a Product B. Design a product C. Prepare production drawings as per design D. Develop prototype model of product E. Prepare technical project report
Conduct survey to establish a small scale unit	A. Conduct market survey to identify product to be produced B. Prepare feasibility report of product C. Convince financial organizations D. Approach government agencies for technical and financial help E. Learn leadership qualities
Develop working models and upgrade/repair existing equipment	A. Develop working model using scientific and engineering principles B. Repair equipment of existing machines