**JNTUH COLLEGE OF ENGINEERING HYDERABAD (Autonomous)**
**JNTUH, Kukatpally, Hyderabad – 500 085**
**Telangana, India**

**ACADEMIC REGULATIONS**
**COURSE STRUCTURE AND SYLLABUS**

# Mechanical Engineering

with Masters Specialization in

# Structural Mechanics

***For***

**FIVE YEAR INTEGRATED**
**DOUBLE DEGREE MASTERS PROGRAM (IDDMP)**
**Leading to B.Tech., M.Tech. at JNTUH and**
**M. Sc. at Blekinge Institute of Technology, Sweden**

***(Applicable for the Batches admitted from 2014-2015)***

**JNTUH**

**BTH, Sweden**

**JNTUH COLLEGE OF ENGINEERING HYDERABAD (Autonomous)**
**JNTUH, Kukatpally, Hyderabad – 500 085**
**Telangana, India**
**2014**

**JNTUH COLLEGE OF ENGINEERING HYDERABAD (Autonomous)**
**JNTUH, Kukatpally, Hyderabad – 500 085**
**Telangana, India**

**JNTUH** **BTH, Sweden**

ACADEMIC REGULATIONS COURSE STRUCTURE AND SYLLABI
*For*
FIVE YEAR INTEGRATED DOUBLE DEGREE MASTERS PROGRAM (IDDMP)
Leading to B. Tech., M. Tech. at JNTUH and M. Sc. at Blekinge Institute of Technology, Sweden
*(Applicable for the Batches admitted from 2014-2015)*
In

# Mechanical Engineering

with Masters Specialization in

# Structural Mechanics

**1) Five Year Integrated Double Degree Masters Program:**

JNTUH offers Five Years (10 Semesters) Integrated Double Degree Masters Program (IDDMP) under MOU with Blekinge Institute of Technology, (BTH), Sweden in the following Branches of Engineering, at its Constituent Autonomous College - JNTUH College of Engineering, Hyderabad, with effect from the Academic Year 2014 – 15 onwards.

| S. No. | UG Program | PG Program | |
|---|---|---|---|
| | | ***M.Sc. at BTH, Sweden (Specialization)**** | ***M. Tech. at JNTUH, India (Specialization)**** |
| 1. | B. Tech. in Electronics & Communication Engineering (ECE) | M.Sc. ( Electrical Engineering with emphasis on Telecommunication Systems) | M. Tech. (Telecommunication Systems) |
| 2. | B. Tech. in Electronics & Communication Engineering (ECE) | M.Sc. ( Electrical Engineering with emphasis on Signal Processing) | M. Tech. (Signal Processing) |
| 3. | B. Tech. in Electronics & Communication Engineering (ECE) | M.Sc. ( Electrical Engineering with emphasis on Radio Communications) | M. Tech. (Radio Communications) |
| 4. | B. Tech. in Computer Science & Engineering | M.Sc. (Computer Science) | M. Tech. (Computer Science & Engineering) |

| | | | |
|---|---|---|---|
| 5. | B. Tech. in Computer Science & Engineering | M.Sc. (Software Engineering) | M. Tech. (Software Engineering) |
| 6. | B. Tech. in Mechanical Engineering | M.Sc. (Structural Mechanics) | M. Tech. (Structural Mechanics) |

***(* A Minimum of 50% of intake/sanctioned students strength is necessary for any specialization to be offered.)***

A student would be conferred the B. Tech., M. Tech. and M. Sc. Degrees in this IDDMP, after the successful completion of all the requirements for the 10 Semesters of study and earning the appropriate credits.

**2) Eligibility of Admission:**

2.1 Admission to the IDDMP shall be made either on the basis of JEE (Main) rank or the merit rank obtained by the qualifying examination at an Entrance Test conducted by the AP State Government (EAMCET), OR the University, OR on the basis of any other order of merit approved by the University.

2.2 Students opting for the 5 Year IDDMP must specify their choice for M. Tech. and M. Sc.(with the specialization given above), after choosing the appropriate Branch of Engineering, at the time of Admissions only. Option thus exercised is final, and cannot be changed during the study period.

2.3 Students opting for 5 Year IDDMP have to study for the specified period, to earn the relevant credits for the award of the B. Tech, M. Tech & M. Sc. Degrees, and they will not be permitted to have a choice for B. Tech. Degree alone after 4 years study.

**3) IDDMP Structure:**

3.1 The Integrated Double Degree Masters Program comprises of two parts – B. Tech. or UG Program and M. Tech. & M. Sc. or PG Program. The UG and PG Programs have the following groups or categories or components, which may include theory subjects / Laboratory courses / Design / Practicals / Major projects etc. as well.

| **S. No.** | **UG/PG Program** | ***Group/Category/Component*** | ***Description*** |
|---|---|---|---|
| 1) | UG | BS – Basic Sciences | Includes - Mathematics, Physics and Chemistry Subjects |
| 2) | UG | EAS - Engineering Arts and Sciences | Include fundamental engineering subjects |
| 3) | UG | HSS – Humanities and Social Sciences | Includes subjects related to Humanities, Social Sciences and Management |
| 4) | UG | DE – Departmental Electives | Includes Elective subjects related to the parent discipline, department or branch of engineering |
| 5) | UG | DC – Departmental Core | Includes core subjects related to the parent discipline, |

| | | | |
|---|---|---|---|
| | | | department or branch of engineering |
| 6) | UG | OE – Open Electives | Elective subjects which include inter-disciplinary subjects or subjects in an area outside the parent discipline, department or branch of engineering |
| 7) | UG | Project | B. Tech. Project or UG Project or UG Major Project |
| 8) | PG | PGC | PG Core Subjects related to the M. Tech. & M. Sc. specialization |
| 9) | PG | PGE | PG Elective Subjects related to the M. Tech. & M. Sc. Specialization |
| 10) | PG | Thesis / Dissertation / Project | PG Project / Thesis / Dissertation in M. Tech. & M. Sc. Specialization |
| 11) | PG | Comprehensive Viva | Comprehensive Viva based on UG & PG Subjects |

**Note :** The PG subjects / Lab / Electives / Thesis / Dissertation / Comprehensive viva as indicated above are tentative. The actual details of courses / Labs / Project / Majors / minors / Seminars etc. will be as per the norms and procedures of BTH, Sweden corresponding PG specialization.

3.2 In the IDDMP, each Subject, Lab., Project, Industrial Training / Seminar / Comprehensive Viva etc. - has specified credits, as indicated in the Course Structure. The credit requirements for IDDMP are: (i) at UG Level: 174 credits at B. Tech. level, plus (ii) at PG Level: 80 credits at M. Tech. & M. Sc.. level.

3.3 The minimum instruction days for each Semester shall be 90 working days. In a Semester, one lecture hour per week is rated as one credit, and two tutorial or two practical hours per week may be rated as one credit in general.

3.4 There shall be no branch transfers at UG Level, and no changes of specializations at PG Level, after the completion of the First Admission Process.

3.5 The Course Structure and Curriculum for the first 3 years (6 Semesters) would be same as that for earning the Regular 4 Year B. Tech. degree in the respective Branch of Engineering. The PG Project Work for the M. Tech. degree shall commence at the beginning of V Year I Semester, and shall be carried out up to the end of the V Year II Semester at BTH, Sweden.

**4) Course Work:**

4.1 A student after securing admission must pursue the 5 Year Integrated Double Degree Master Program of study for a duration of 10 Semesters (or 5 years). Each Semester shall be of 22 weeks duration (inclusive of examinations), with 16 weeks of instruction days at JNTUH up to 7 Semesters and the remaining Semesters will be as per the regulations of BTH.

4.2 Course work up to and inclusive of IV Year I Semester shall be conducted at JNTUH, IV year II semester and V Year I & II semesters shall be at Blekinge Institute of Technology (BTH), Sweden.

4.3 The student must secure a total of 254 credits for the IDDMP - 174 credits for the B. Tech. degree Program, plus 80 credits for the M. Tech. & M. Sc. Program, under different categories as indicated in Item 3.1 and 3.2.

4.4 The student should complete the IDDMP within a period equal to twice the prescribed duration of the Program, from the Date of Admission. Students, who fails to fulfill all the academic requirements for the award of the Double Degrees within 10 academic years from the Date of Admission, shall forfeit their seat in both B. Tech., M. Tech. & M. Sc. Courses.

**5) Attendance Requirements at JNTUH:**

5.1 The student shall be eligible to appear for the Semester End Examinations, if he acquires a minimum of 75% attendance in aggregate of all the subjects put together up to IV Year - I Semester in each Semester.

5.2 Condonation of shortage of attendance in aggregate up to 10% (net attendance of 65% and above, and below 75%) in each Semester may be granted by the College Academic Committee. Such condonation shall be granted only on genuine and valid reasons, on representation by the candidate with supporting evidence, and on payment of the stipulated condonation fee.

5.3 Shortage of attendance below 65% in aggregate shall NOT be condoned.

5.4 Students, whose shortage of attendance is not condoned in any Semester, are not eligible to take their End Examinations of that Semester, and their registration for that Semester shall stand cancelled.

5.5 A student shall not be promoted to the next Semester, unless he satisfies the attendance requirement of the present Semester. In such cases, the student may seek re-admission for that Semester, as and when offered.

**6) Academic Requirements:**

The following academic requirements have to be satisfied, in addition to the attendance requirements specified in Item 5.

6.1(a) **U.G. Part:** A student shall be deemed to have satisfied the minimum academic requirements and earned the credits allotted to each theory subject / practical subject /design /drawing subject / UG Project, if he secures not less than 35% of marks in the end examination (25 out of 70 marks, or 18 out of 50 marks as case may be), and a minimum of 40% marks in the sum total of the internal evaluation and end examination taken together.

(b) **P.G. Part:** A student shall be deemed to have satisfied the minimum academic requirements and earned the credits allotted to each theory subject / practical subject / design / drawing / Comprehensive Viva-voice, if he secures a minimum of 40% of marks in the end examination, and a minimum of 50% marks in the sum total of the internal evaluation and end examination taken together.

6.2 A student shall be **promoted from II to III year** only if he fulfills the academic requirements of earning **40 credits from two regular and one supplementary examinations of I year I Semester, and One Regular & One Supplementary exam of I year II Semester, and one regular examination of II year I Semester** irrespective of whether the candidate takes the examination or not.

6.3 A student shall be **promoted from III year to IV year** only if he fulfils the academic requirements of earning total **67 credits from the following examinations,** whether the candidate takes the examinations or not.

a. Three regular and two supplementary examinations of I B Tech – I Semester.
b. Two regular and two Supplementary examinations of I B Tech II Semester
c. Two regular and one supplementary examinations of II year – I Semester.
d. One regular and one supplementary examinations of II year II Semester.
e. One regular examination of III year I Semester

**6.4 A student shall be eligible to proceed to BTH, Sweden for admission into IV Year II Semester level, if he completes all the subjects and earned all the credits up to III B. Tech, I Semester and UG (Bachelor) Project during IV B. Tech - I Semester at JNTUH.**

6.5 The credits earned by each student at JNTUH (inclusive of UG & PG) shall be transferred to BTH, Sweden, only after the student successfully completes and earns all credits up to and inclusive of IV year I semester along with UG Project.

6.6 A student shall be eligible to appear for the end Semester examination in any Subject (Theory/ Lab.) or Seminar/ Comprehensive Viva/ Project etc., but absent at it or has failed in the end examination, may appear for the same at the supplementary examination or subsequent examination as and when offered.

6.7 (a) When a student is detained due to shortage of attendance in any Semester, he may be re-admitted into that Semester when it is next offered, **with the academic regulations of the batch into which he got readmitted.**

(b) When a student is detained due to lack of credits in any year, he may be readmitted into the next year after fulfillment of the academic requirements, **with the academic regulations of the batch into which he got readmitted**

6.8 A student shall register for all the 254 credits as specified in the Course Structure and put up the minimum attendance requirements in all the Semesters, and earn all the 254 (174 at UG level + 80 at PG level) credits for the IDDMP. Marks obtained in all the specified 174 UG credits shall be considered for the calculation of percentage of marks for the B. Tech. Program, and the marks obtained in all the specified 80 PG credits shall be considered for the calculation of % of marks for the M. Tech. & M.Sc. Program. Evaluation of M. Sc. programme performance will be as per BTH norms in vogue.

6.9 Students, who fail to earn the 174 UG credits as indicated in the Course Structure, within 8 Academic Years from the Date of Admission, shall forfeit their seat in the IDDMP, and their admission for the entire Double Degree Masters Program shall stand cancelled.

6.10 Students, having secured the 174 UG credits, but fail to earn all the specified PG credits as indicated in the Course Structure, within 10 Academic Years from the Date of Admission, shall forfeit their seat in the IDDMP, and their registration/ continuation for the PG Degree Program shall stand cancelled.

**7) Evaluation Procedure:**

The performance of a student shall be evaluated in each Semester Subject wise as follows:

**7.1 <u>For UG Part of the IDDMP</u>**

i) The performance of a student shall be evaluated in each Semester Subject wise with a maximum of 100 marks for Theory and 75 marks for Practical/Laboratory subject. In addition the project work shall be evaluated for 200 marks.

ii) For theory subjects, the distribution shall be **30 marks for Internal Evaluation and 70 marks for the End-Examination**.

iii) For theory subjects, during the Semester there shall be **2 mid-term examinations.** Each mid-term examination consists of **one objective paper for 10 marks, one subjective paper for 15 marks with a duration of 110 minutes (20 minutes** for objective and **90 minutes** for subjective paper), and one Assignment for 5 marks. Objective paper shall be set with multiple choice questions, true/false, fill-in the blanks, matching type questions, etc. for 10 marks. Subjective paper shall contain 5 questions, out of which the student has to answer 3 questions, each for 5 marks. The first mid-term examination shall be conducted for the first 50% of the syllabus, and second mid-term examination shall be conducted for the remaining 50% of the syllabus. First Assignment should be submitted before the conduct of the first mid examinations, and the second Assignment should be submitted before the conduct of the second mid examinations. The Assignment shall be as specified by the concerned subject teacher. The total marks secured by the student, in each mid-term examination, are evaluated for 30 marks and the better of the two mid-term examinations shall be taken as the final marks secured by each candidate.

iv) For practical subjects there shall be a continuous evaluation during the Semester for **25 sessional marks and 50 end examination marks**. Out of the 25 marks for internal, **day-to-day work in the laboratory shall be evaluated for 15 marks**, and **two internal examinations for practical's each of 10 marks,** shall be conducted by the concerned laboratory teachers. The **better of two** internal exams shall be considered. The End Examination shall be conducted by the teacher concerned and another faculty member of the same Department, as suggested by the Head of Dept.

v) For the Subject having design and / or drawing, (such as Engineering Graphics, Engineering Drawing, Machine Drawing and Estimation etc.), the distribution shall be **30 marks for internal evaluation (15 marks for day-to-day work and 15 marks for internal tests) and 70 marks for end examination.** There shall be two internal tests in a Semester and the **better of the two** shall be considered for the award of marks for internal tests.

vi) **Open Electives:** Students are to choose One Open Elective (OE-I) during 3rd Year I-Semester and another Open Elective (OE-II) during 3rd Year II-Semester from the corresponding list of Open Electives given. However, students cannot opt for an Open

Elective subjects offered by their own department, if it is already listed under core / elective subjects offered by that department in any Semester.

vii) The UG Project shall be evaluated for 200 marks, out of which 60 marks shall be for Internal Evaluation and 140 marks for the End Semester Viva-Voce Examination. Out of 60 marks allocated for internal evaluation, 30 marks shall be awarded by the Project Supervisor (based on his continuous performance evaluation of the student), and the other 30 marks shall be awarded by Project Evaluation Committee (PEC) based on the presentation made by the student on the progress of the project at the time of IV Year I Semester I & II-Mid examinations. The PEC shall be constituted by the Head of the Department and shall consist of the Head of the Department, the Supervisor of UG Project and Senior Faculty Member of the Department.

**7.2 <u>For M. Tech. (PG) Part of the IDDMP at JNTUH</u>**

i) Theory Subjects are evaluated for 100 marks, and practicals/Laboratory Subjects are also Evaluated for 100 marks.

ii) For theory subjects, the distribution shall be 40 marks for Internal Evaluation and 60 marks for the End-Examination. For the award of the 40 Internal (sessional) marks for theory subjects, there shall be 2 internal examinations during the Semester, one at the middle of the Semester and the other immediately after the completion of instruction; each of which shall be evaluated for 25 marks, and the better one out of these two internals shall be considered for awarding the 25 sessional marks. Out of the remaining 15 sessional marks, 5 marks are allocated for teacher's assessment (allotment is based on performance of the student in the concerned subject/class) and 10 marks will be awarded based on the student's performance in the Assignments.

iii) For practical's/Laboratory subjects, there shall be a continuous evaluation during the Semester for 40 sessional marks and 60 End Examination marks. Of these 40 marks, 15 marks shall be awarded for day-to-day work and 25 marks to be awarded by conducting an internal laboratory test. The End Examination shall be conducted by the teacher concerned and another faculty member of the same Department, as suggested by the Head of Dept.

**7.3** For M. Sc. (PG) part of the IDDMP at BTH, Sweden, the concerned subjects, regulations and evaluation procedure offered shall be as per the norms in vogue at BTH, Sweden.

**7.4 Grading Procedure (Common for M. Tech. & M. Sc.)**

i) Marks will be awarded to indicate the performance of each student in each Theory Subject or Practical or UG Project or comprehensive viva voce etc. at JNTUH as specified above in Items 7.1, 7.2, & 7.3 and a proportional letter grade shall be given.
ii) As a measure of the student's performance, a Grading System using the following letter grades and corresponding percentage of marks shall be followed.

***For UG at JNTUH:**

| *% of Marks Secured at JNTUH* | *Letter Grade at JNTU* |
|---|---|
| 70% and above | A |
| Below 70%<br>but not less than 60% | B |
| Below 60% | C |

| | |
|---|---|
| but not less than 50% | |
| Below 50%<br>but not less than 40% | D |
| Below 40% | F |

***For PG at JNTUH:**

| *% of Marks Secured at JNTUH* | *Letter Grade at JNTUH* |
|---|---|
| 70% and above | A |
| Below 70%<br>but not less than 60% | B |
| Below 60%<br>but not less than 50% | C |
| Below 50% | F |

***For PG at BTH, Sweden**

| *% of Marks Secured at JNTUH* | *Letter Grade Equivalent at BTH, Sweden* |
|---|---|
| Less than or equal to 100%<br>but not less than 90% | A |
| Below 90%<br>but not less than 80% | B |
| Below 80%<br>but not less than 70% | C |
| Below 70%<br>but not less than 60% | D |
| Below 60%<br>but not less than 50% | E |
| Below 50% | F |

**8) Award of Degree or Class:**

After a student satisfies all the requirements prescribed for the completion of the IDDMP and becomes eligible for the award of the respective Degree, he shall be placed in one of the following four classes ~

**For UG at JNTUH:**

| *Class Awarded in UG Program* | *% of Marks Secured at JNTUH* | *Program Credits at JNTUH* |
|---|---|---|
| FIRST CLASS with DISTINCTION | 70% and above | From the Aggregate secured for the 174 UG credits. |
| FIRST CLASS | Below 70%<br>but not less than 60% | |
| SECOND CLASS | Below 60%<br>but not less than 50% | |
| PASS CLASS | Below 50%<br>but not less than 40% | |

**For PG:**

| Class Awarded in PG at JNTUH | % of Marks Secured at JNTUH | Equivalence between BTH grade and JNTUH marks for the purpose of award of class<br>**BTH Grade# = JNTUH Marks** |
|---|---|---|
| FIRST CLASS with DISTINCTION | 70% and above | **A = 95%** |

| | | |
|---|---|---|
| FIRST CLASS | Below 70% but not less than 60% | **B = 85%** **C = 75%** |
| SECOND CLASS | Below 60% but not less than 50% | **D = 65%** **E = 55%** |
| FAIL | Below 50% | **F < 50%** |

**# Note: If any unspecified symbol/ character is given by BTH, Sweden as the ECTS grade for any subject the corresponding ratification for the appropriate specified grade shall be obtained from BTH, Sweden, and corresponding percentage marks will be awarded at JNTUH.**

**JNTUH awards the**

- B. Tech. Degree with specialization in **Mechanical Engineering** after securing for 174 UG credits at JNTUH
- M. Tech. Degree with specialization in **Structural Mechanics** after securing a total of 80 PG credits (JNTUH) equivalent to 120 ECTS at BTH.

**BTH awards the**

- M. Sc. Degree in Electrical Engineering with emphasis on **Structural Mechanics** specialization after securing a total of 120 ECTS (BTH) equivalent to 80 PG credits at JNTUH.

**9) Transfer of Credits Policy between JNTUH and BTH, Sweden for awarding PG degrees:**

a) JNTUH offers 20 credits for PG in IV Year I Semester for this Integrated Double Degree Masters program, which will be transferred to BTH as 30 credits of European Credit Transfer System (ECTS).

b) The 30 ECTS offered in each Semester at BTH for PG in IV year II Semester, V year I and II Semesters are transferred to JNTUH, which will be equivalent to 20 credits at JNTUH.

**10) Withholding of Results:**

If the student has not paid dues to University/College, or if any case of indiscipline is pending against him, the result of the candidate may be withheld and he will not be allowed to go into the next higher Semester. The award or issue of the Degree may also be withheld in such cases.

**11) Transitory Regulations:**

Students who have discontinued or have been detained for want of attendance, or who have failed after having undergone the IDDMP, may be considered eligible for readmission to the same or equivalent subjects as and when they are offered, subject to Item 6.9 and 6.10.

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## MALPRACTICES RULES

| | Nature of Malpractices | Punishment |
|---|---|---|
| | **If the candidate:** | |
| 1 (a) | Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination) | Expulsion from the examination hall and cancellation of the performance in that subject only. |
| 1 (b) | Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter. | Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him. |
| 2 | Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing. | Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year.<br>The Hall Ticket of the candidate is to be cancelled. |
| 3 | Impersonates any other candidate in connection with the examination. | The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him. |
| 4 | Smuggles in the Answer book or | Expulsion from the examination hall and |

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|---|---|---|
| | additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination. | cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. |
| 5 | Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks. | Cancellation of the performance in that subject. |
| 6 | Refuses to obey the orders of the Chief Superintendent / Assistant – Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination. | In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them. |
| 7 | Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall. | Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The |

| | | |
|---|---|---|
| | | continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. |
| 8 | Possess any lethal weapon or firearm in the examination hall. | Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. |
| 9 | If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8. | Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them. |
| 10 | Comes in a drunken condition to the examination hall. | Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. |
| 11 | Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny. | Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester / year examinations. |
| 12 | If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the College / University for further action to award suitable punishment. | |

**12) General:**

- The Academic Regulations should be read as a whole for the purpose of any interpretation.
- The University/College reserves the right of altering the Academic Regulations and/or Syllabus/Course Structure, as and when necessary. The modifications or amendments may be applicable to all the candidates on rolls, as specified by the University/College.

- Wherever the words ‘he’ or ‘him’ or ‘his’ occur in the above regulations, they will also include ‘she’ or ‘her’ or ‘hers’.
- Wherever the word ‘Subject’ occurs in the above regulations, it implies the ‘Theory Subject’ and ‘Practical Subject’ or ‘Lab.’.
- In case of any ambiguity or doubt in the interpretations of the above regulations, the decision of the CAC / Academic Senate / Vice-Chancellor will be final.
- There shall be no branch transfers, no place transfers, no course transfers, and no transfers from 5 year IDDMP to 4 year B. Tech. (Regular) degree programme (Of same branch or any other branch) or Vice versa, after the completion of the admission process.
- The visa will be issued by the respective embassy, the student is required to fulfill the necessary norms. Students are responsible to show the required financial proofs to the migration authorities while applying for student permit (VISA). Either JNTUH or BTH will not be responsible for the visa rejections caused on the grounds of in-sufficient financial funds/statements or any other issues in front of Migration Board.

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**ACADEMIC REGULATIONS**
**COURSE STRUCTURE AND SYLLABUS**

# Mechanical Engineering

with Masters Specialization in

# Structural Mechanics

***For***

**FIVE YEAR INTEGRATED**
**DOUBLE DEGREE MASTERS PROGRAM (IDDMP)**
**Leading to B.Tech., M.Tech. at JNTUH and**
**M. Sc. at Blekinge Institute of Technology, Sweden**

***(Applicable for the Batches admitted from 2014-2015)***

**JNTUH**

**BTH, Sweden**

**JNTUH COLLEGE OF ENGINEERING HYDERABAD (Autonomous)**
**JNTUH, Kukatpally, Hyderabad – 500 085**
**Telangana, India**
**2014**

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**
**(AUTONOMOUS)**

**MECHANICAL ENGINEERING**

**COURSE STRUCTURE**
(applicable from the batch admitted during 2014-15 and onwards)

**I YEAR** **I SEMESTER**

| S.No. | Group | Subject | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | BS | Mathematics - I | 4 | 1 | 0 | 4 |
| 2 | BS | Engineering Physics | 4 | 0 | 0 | 4 |
| 3 | BS | Applied Chemistry | 4 | 0 | 0 | 4 |
| 4 | EAS | Computer Programming & Data Structures | 4 | 1 | 0 | 4 |
| 5 | EAS | Engineering Mechanics | 4 | 1 | 0 | 4 |
| 6 | BS | Engineering Physics Lab | 0 | 0 | 3 | 2 |
| 7 | BS | Applied Chemistry Lab | 0 | 0 | 3 | 2 |
| 8 | EAS | Computer Programming & Data Structures Lab | 0 | 0 | 3 | 2 |
| | | NSS / NCC | | | | |
| | | **Total Credits** | | | | **26** |

**I YEAR** **II SEMESTER**

| S.No. | Group | Subject | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | BS | Mathematics – II | 4 | 1 | 0 | 4 |
| 2 | EAS | Basic Electrical & Electronics Engineering | 4 | 1 | 0 | 4 |
| 3 | HSS | English | 4 | 0 | 0 | 4 |
| 4 | EAS | Engineering Graphics | 3 | 0 | 3 | 4 |
| 5 | HSS | Environmental Science | 4 | 0 | 0 | 4 |
| 6 | BS | Computational Mathematics | 2 | 0 | 0 | 2 |
| 7 | EAS | Engineering Workshop | 0 | 0 | 3 | 2 |
| 8 | HSS | English Language Communication Skills Lab | 0 | 0 | 3 | 2 |
| 9 | BS | Computational Mathematics Lab | 0 | 0 | 3 | 2 |
| | | NSS/NCC | | | | |
| | | **Total Credits** | | | | **28** |

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**
**(AUTONOMOUS)**

**MECHANICAL ENGINEERING**

**COURSE STRUCTURE**

**II YEAR** **I SEMESTER**

| S.No. | Group | Subject | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | BS | Mathematics -III | 4 | 1 | 0 | 4 |
| 2 | DC | Metallurgy & Material Science | 4 | 1 | 0 | 4 |
| 3 | DC | Mechanics of Solids | 4 | 1 | 0 | 4 |
| 4 | DC | Thermodynamics | 4 | 1 | 0 | 4 |
| 5 | DC | Kinematics of Machines | 4 | 1 | 0 | 4 |
| 6 | DC | Machine Drawing practice Lab | 0 | 0 | 3 | 2 |
| 7 | DC | Mechanics of Solids & Metallurgy Lab | 0 | 0 | 3 | 2 |
| 8 | DC | Fuels & lubricants Lab | 0 | 0 | 3 | 2 |
| | | **TOTAL** | | | | **26** |

**II YEAR** **II SEMESTER**

| S.No. | Group | Subject | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | DC | Fluid Mechanics & Hydraulic Machinery | 4 | 1 | 0 | 4 |
| 2 | DC | Thermal Engineering-I | 4 | 1 | 0 | 4 |
| 3 | DC | Dynamics of Machines | 4 | 1 | 0 | 4 |
| 4 | DC | Production Technology | 4 | 1 | 0 | 4 |
| 5 | DC | Instrumentation & Control Systems | 4 | 1 | 0 | 4 |
| 6 | DC | Fluid Mechanics & Hydraulic Machinery Lab | 0 | 0 | 3 | 2 |
| 7 | DC | Instrumentation & control system Lab | 0 | 0 | 3 | 2 |
| 8 | DC | Production Technology Lab | 0 | 0 | 3 | 2 |
| 9 | HSS | Human Values and Professional Ethics | 2 | 0 | 0 | 2 |
| | | **TOTAL** | | | | **28** |

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**
**(AUTONOMOUS)**

**MECHANICAL ENGINEERING**

**COURSE STRUCTURE**

**III YEAR** **I SEMESTER**

| S.No. | Group | Subject | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | DC | Design of Machine Members-I | 4 | 1 | 0 | 4 |
| 2 | DC | Thermal Engineering -II | 4 | 1 | 0 | 4 |
| 3 | DC | Metrology | 4 | 1 | 0 | 4 |
| 4 | OE-I | Open Elective-I | 4 | 0 | 0 | 4 |
| 5 | DC | Managerial Economics and Financial Analysis | 4 | 0 | 0 | 4 |
| 6 | DC | Thermal Engineering Lab | 0 | 0 | 3 | 2 |
| 7 | DC | Metrology Lab | 0 | 0 | 3 | 2 |
| 8 | HSS | Advanced English Language Communication Skills Lab | 0 | 0 | 3 | 2 |
| | | **TOTAL** | | | | **26** |

**III YEAR** **II SEMESTER**

| S.No. | Group | Subject | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | DC | CAD/CAM | 4 | 1 | 0 | 4 |
| 2 | DC | Heat Transfer | 4 | 1 | 0 | 4 |
| 3 | OE-II | Open Elective -II | 4 | 0 | 0 | 4 |
| 4 | DE-I | Departmental Elective-I | 4 | 0 | 0 | 4 |
| 5 | DE-II | Departmental Elective – II | 4 | 0 | 0 | 4 |
| 6 | DC | Kinematics & Dynamics Lab | 0 | 0 | 3 | 2 |
| 7 | DC | Heat Transfer Lab | 0 | 0 | 3 | 2 |
| 8 | DC | Computer Aided Engineering Lab | 0 | 0 | 3 | 2 |
| 9 | EAS | Disaster management | 2 | 0 | 0 | 2 |
| | | **TOTAL** | | | | **28** |

**Summer between III & IV Year: UG Project: 4 credits***
***(UG Project continued into IV year I semester))**

**JNTUH COLLEGE OF ENGINEERING HYDERABAD.**
**(AUTONOMOUS)**

**MECHANICAL ENGINEERING**

**COURSE STRUCTURE**

**IV YEAR** **I SEMESTER**

| S.No. | Group | Subject | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | DC (UG) | UG Project | | | | 4*+8 |
| 2 | PGC | PG Core Principles of Signal Processing | 4 | 1 | 0 | 4+1 |
| 3 | PGE-I | PG Elective-I (Industrial Robotics) | 4 | 1 | 0 | 4+1 |
| 4 | PGE-II | PG Elective-II (Mechatronics) | 4 | 0 | 0 | 4 |
| 5 | PGC | PG Laboratory Strucutral Mechanics & Robtics Lab (Using Ansys/Abaqus) | 0 | 0 | 6 | 4 |
| 6 | PG | Comprehensive Viva | - | - | - | 2 |
| | | Total | | | | 4*+28 |

(* 4 credits for the UG project carried out during the summer after 3rd Year –II Semester).

**IV-II AND V-I & II Semesters at BTH Sweden**

**Each Semester in BTH-Sweden, is divided into two Groups ( LP1&LP2 in IV-II semester, LP3 & LP4 in V-I Semester and V-II Semester Project work). Students have to take only 2 subjects per Learning Period (LP) each subject with 7.5 ECTS. Total of 4x7.5=30 ECTS per Semester and 90 ECTS at BTH**. The subjects will be notified at the time of entry to the semester.

**Open Elective-I**

| S.No. | Subject | Offering Department |
|---|---|---|
| 1. | GIS & Remote Sensing | Civil Engineering |
| 2. | Non Conventional Power Generation | Electrical & Electronics Engineering |
| 3. | Operations Research | Mechanical Engineering |
| 4. | Electronic Measurements & Instrumentation | Electronics & Communication Engineering |

| | | |
|---|---|---|
| 5. | OOPS through JAVA | Computer Science & Engineering |
| 6. | Data Structures and Analysis of Algorithms | Computer Science & Engineering |
| 7. | Operating Systems | Computer Science & Engineering |
| 8. | Material Science | Metallurgical Engineering |
| 9. | Nano Technology | Physics |
| 10 | Engineering Management | Humanities & Social Sciences |

**Open Elective-II**

| S.No. | Subject | Offering Department |
|---|---|---|
| 1. | Estimation, Quantity survey & Valuation | Civil Engineering |
| 2. | Energy Storage Systems | Electrical & Electronics Engineering |
| 3. | Mechatronics | Mechanical Engineering |
| 4. | Principles of Communication Systems | Electronics & Communication Engineering |
| 5. | E-Commerce | Computer Science & Engineering |
| 6. | Computer Graphics | Computer Science & Engineering |
| 7. | Database Management Systems | Computer Science & Engineering |
| 8. | Nano Materials | Metallurgical Engineering |
| 9. | Intellectual Property Rights | Humanities & Social Sciences |
| 10. | Entrepreneurship | Humanities & Social Sciences |

**Departmental Elective-I**

1. Automobile Engineering
2. Non-Conventional Sources of Energy
3. Tribology
4. Neural networks & fuzzy logics
5. Plant Layout and Material Handling

**Departmental Elective-II**

1. Power Plant Engineering
2. Advanced Mechanics of Composite Materials
3. Production Planning & Control
4. Modern Control Theory
5. Fluid Power Systems

**PG Elective-I**

1. Industrial Robotics
2. Fracture Mechanics
3. Expremental stress Analysis
4. Advanced Mechanics of solids

**PG Elective-II**

1. Mechatronics
2. Vehicle Dynamics
3. Random Vibrations
4. Theory of elastisity

## COURSES OFFERED AT BLEKINGE INSTITUTE OF TECHNOLOGY, SWEDEN

(FROM IV –II SEMESTER ONWARDS)

**IV-II AND V-I & II Semester Courses at BTH Sweden**

a) The courses offered by Blekinge Institute of Technology, Sweden from IV-II semester onwards

**IV Year II Semester III Study Period**

| Serial # | Course Slot | Course | Credits | BTH Internal ID |
|---|---|---|---|---|
| 1. | Mandatory 1 | Research Methodology with Emphasis on Engineering Science | 7,5 | |
| 2. | Mandatory 2 | Structural Analysis | 7,5 | |

**IV Year II Semester IV Study Period**

| Serial # | Course Slot | Course | Credits | BTH Internal ID |
|---|---|---|---|---|
| 3. | Mandatory 3 | Computational Engineering I | 7,5 | |
| 4. | Mandatory 4 | Sound and Vibration Analysis | 7,5 | |

**V Year I Semester I Study Period**

| Serial # | Course Slot | Course | Credits | BTH Internal ID |
|---|---|---|---|---|
| 5. | Mandatory 5 | Computational Engineering 2* (Continued...) | 7,5 (15) | |
| 6. | Mandatory 6 | Experimental Model Analysis | 7,5 | |

**V Year I Semester II Study Period**

| Serial # | Course Slot | Course | Credits | BTH Internal ID |
|---|---|---|---|---|
| 7. | Mandatory 5 | Computational Engineering 2 | 7,5 (15) | |
| 8. | Elective 1 | | 7,5 | |

| V Year | II Semester | | III Study Period | |
|---|---|---|---|---|
| Serial # | Course Slot | Course | Credits | BTH Internal ID |
| 9. | Mandatory 7 | Master's Thesis (120 Credits) in Mechanical Engineering | 15 (30) | |

| V Year | II Semester | | IV Study Period | |
|---|---|---|---|---|
| Serial # | Course Slot | Course | Credits | BTH Internal ID |
| 9. | Mandatory 7 | Master's Thesis (120 Credits) in Mechanical Engineering | 15 (30) | |

**List of elective courses for Elective 1 Course:**[1]

The students are expected to study one Elective Courses from the eligible courses provided in the list, corresponding to 7,5 ECTS credits

- Fracture Mechanics, 7,5
- Optimisation, 7,5
- Physical Acoustics, 7,5

b) The courses for IV-I Semester of IDDMP to be included in Master's degree at BTH:

c) In order to qualify for a 120 credits Master's degree from BTH, the following below courses (1-5)
from IV-I semester of IDDMP Program of JNTUH will be considered for crediting to Master's programs for the award of Masters degree at BTH and will be treated as 30 ECTS Credits.

1. PGC : Signal Processing
2. PGE : Mechatronics
3. PGE : Industrial Robotics
4. PGC : Structural Mechanics and Robotics Lab
5. PGC : Comprehensive Viva-Voce
6. UGC : Bachelors Project (Continued... from summer period between III-II and IV-I Semester)[2]

d) The courses of Bachelor education as per the curricula of first year, second year and third year and undergraduate project of IDDMP as prerequisites background for masters education at BTH.

[1] Eligible Courses will be offered to student as per the availability of resources.

[2] UG Project will be only considered for bachelor education.

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**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**I Year B.Tech. Mech. Engg. I-Sem**

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## MATHEMATICS-I
## (Common for all Branches)

**UNIT – I: Differential calculus**

Rolle's Mean value Theorem – Lagrange's Mean Value Theorem – Cauchy's mean value Theorem – (all theorems without proof but with geometrical interpretations), verification of the Theorems and testing the applicability of these theorem to the given function. Radius, Center and circle of curvature – Evaluates and Envelopes, Curve tracing – Cartesian, polar and parametric curves.

Functions of several variables – Functional dependence- Jacobian- Maxima and Minima of functions of two variables with constraints and without constraints-Method of Lagrange multipliers.

**UNIT – II: Improper Integrals, Multiple Integration**

Gamma and Beta Functions –Relation between them, their properties – evaluation of improper integrals using Gamma / Beta functions

Multiple integrals – double and triple integrals – change of order of integration- change of variables (polar, cylindrical and spherical) Finding the area of a region using Double integration and volume of a region in space using triple integration.

**UNIT – III: Vector Calculus**

Vector Calculus: Scalar point function and vector point function, Gradient- Divergence- Curl and their related properties, - Laplacian operator, Line integral – Work done – Surface integrals –Volume integral. Green's Theorem, Stoke's theorem and Gauss's Divergence Theorems (Statement & their Verification). Solenoidal and irrotational vectors, Finding potential function.

**UNIT – IV: First Order Ordinary Differential Equations**

Overview of differential equations- exact, linear and Bernoulli.

Applications of first order differential equations – Newton's Law of cooling, Law of natural growth and decay, orthogonal trajectories.

**UNIT V: Higher Order Ordinary Differential Equations**

Linear differential equations of second and higher order with constant coefficients, Non-homogeneous term of the type $f(x)= e^{ax}$, Sin ax, Cos ax, and $x^n$, $e^{ax} V(x)$, $x^n V(x)$, method of variation of parameters. Applications on bending of beams, Electrical circuits and simple harmonic motion.

**TEXT BOOKS:**

1. HIGHER ENGINEERING MATHEMATICS BY B S GREWAL.
2. ADVANCED ENGINEERING MATHEMATICS BY PETER V O'NEIL, CENGAGE LEARNING
3. ENGINEERING MATHEMATICS BY ERWIN KREYSZIG,$10^{TH}$ EDITION WIELY PUBLICATIONS

**REFERENCES:**

1. MATHEMATICS FOR ENGINEERS BY K.B.DATTA AND M.A S.SRINIVAS,CENGAGE PUBLICATIONS
2. MATHEMATICS FOR ENGINEERS BY PROF.A R K PRASAD., WIELY INDIA.
3. ENGINEERING MATHEMATICS -1AND 2 BYT.K.V.IYENGAR & B.KRISHNA GANDHI et al

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**I Year B.Tech. Mech. Engg. I-Sem**

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## ENGINEERING PHYSICS
**(Common for Civil, Mechanical and Metallurgical Engg.)**

**UNIT-I**

1. **Interference**: Superposition of Waves, Young's double slit experiment, Coherence, Interference in Thin films by Reflection, Newton's Rings.
2. **Diffraction:** Fresnel and Fraunhofer diffractions, Fraunhofer diffraction at a single slit and Double slit, Diffraction Grating, Resolving Power of a Grating.
3. **Polarization:** Introduction to polarization, Double Refraction, Nicol Prism, Quarter and Half wave plates

**UNIT-II**

4. **Bonding in Solids**: Ionic Bond, Covalent Bond, Metallic Bond, Hydrogen Bond, Vander-Waal's Bond and Calculation of Cohesive Energy for Ionic Solids.
5. **Crystallography and Crystal Structures**: Space Lattice, Unit Cell, Lattice parameters, Crystal Systems, Bravais Lattices, Miller Indices, Atomic Radius, Co-ordination Number and Packing Factor of SC, BCC, FCC, Diamond Structure(Cubic), Structures of NaCl, ZnS, CsCl, Crystal Planes and Directions, Inter Planar Spacing of Orthogonal Crystal Systems

**UNIT-III**

6. **Defects in Crystals:** Point Defects: Vacancies, Substitutional, Interstitial, Frenkel and Schottky Defects, Estimation of Frenkel and Schottky Defects, Edge and Screw dislocations (Qualitative Treatment), Burger's Vector.
7. **X-ray Diffraction:** Basic Principles of **X**-ray Diffraction, Bragg's Law, Laue Method, Powder Method, Applications of X-ray Diffraction.

**UNIT-IV**

8. **Dielectric Properties:** Basic definitions: Electric dipole, Dipole moment, Permittivity, Dielectric constant, Polarizability, Electric susceptibility, Displacement vector; Electronic Polarization, Ionic Polarization (Quantitative treatment) and Orientation Polarization (Qualitative treatment),Internal Fields in Solids, Clausius - Mossotti Equation, Piezo-electricity, Pyro- electricity and Ferro – electricity,Properties of ferro-electric materials.
9. **Magnetic Properties:** Basic definitions: Magnetic dipole, Magnetic moment, Magnetic Induction, Magnetic field intensity, Permeability, relative permeability, Intensity of Magnetization, susceptibility, Relation between $\chi$ and $\mu_r$ ; Origin of Magnetic Moment-Bohr Magneton, Classification of Dia, Para and Ferro Magnetic Materials on the basis of Magnetic Moment,Domain Theory of Ferro magnetism on the basis of Hysteresis Curve, Soft and Hard Magnetic Materials, Properties of Anti-Ferro and Ferri Magnetic Materials.
10. **Superconductivity:** Introduction of Superconductivity, Properties of Superconductors, Meissner Effect, BCS theory (Qualitative ), Type-I and Type II Superconductors, Magnetic Levitation and Applications of Superconductors.

**UNIT-V**

11. **Acoustics of Buildings:** Basic Requirement of Acoustically Good Hall, Reverberation and Time of Reverberation, Sabine's Formula for Reverberation Time, Measurement of Absorption Coefficient of a material, Factors Effecting the Architectural Acoustics and their Remedies.
12. **Nanomaterials:** Origin of Nanotechnology, Nano Scale, Surface to Volume Ratio, Quantum Confinement, Bottom-up Fabrication: Sol-Gel, Precipitation, combustion Methods; Top-Down Fabrication: Chemical Vapor Deposition, Physical Vapor Deposition, Characterization Techniques (XRD, SEM &TEM) and Applications.

**Text books:**

1. Principles of Physics by Halliday, Resnick, Walker, Wiley India Pvt Ltd, 9th Edition.
2. Introduction to Solid State Physics by Charles Kittel, Wiley India Pvt Ltd, 7th Edition
3. Engineering Physics by R.K.GAUR & S.L.GUPTA, Dhanpat Rai Publications.
4. Solid State Physics by A J Dekker, MACMILLAN INDIA LTD.

**References:**

1. Modern Engineering Physicsby Dr.K.Vijaya Kumar, Dr.S.Chandralingam, S.CHAND & COMPANY LTD
2. Applied Physics by P.K.Mittal, I K International Publishers
3. Applied Physics by P.K. Palanisamy :Scitech publishers
4. Introduction to Nanotechnology by Charles P.Poole, Jr.Frank J ownes, John Wiley & sons
5. Applied Physics for Engineers by P. Madusudana Rao, Academic Publishing Company
6. Engineering Physics by Sanjay D Jain, Girish G Sahasrbudha: University Press.

## JNTUH COLLEGE OF ENGINEERING HYDERABAD

**I Year B.Tech. Mech. Engg. I-Sem**

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## APPLIED CHEMISTRY

**Unit-I: Water and its treatment :**

Introduction – hardness of water – causes of hardness – types of hardness : temporary and permanent – expression and units of hardness – Estimation of hardness of water by complexometric method. Potable water and its specifications. Steps involved in treatment of potable water - Disinfection of potable water by chlorination and Ozonization. Boiler feed water and its treatment – Calgon conditioning – Phosphate conditioning - Colloidal conditioning – External treatment of water – Lime soda and ion-exchange processes. Desalination of water – Reverse osmosis. Numerical problems – Sewage water - COD, BOD and their determination. Treatment of sewage.

**Unit-II: Electrochemistry and corrosion :**

**Electrochemistry :** Conductance - Specific, equivalent and molar conductance . Ionic mobilities – Relationship between ionic conductance and ionic mobilities. Electro Chemical cells - electrode potential and its determination, standard electrode potential, types of electrodes – Standard hydrogen electrode, calomel and glass electrode. Nernst equation - electrochemical series and its applications.– Concept of concentration cell –Numerical problems.

**Corrosion**- Causes and effects of corrosion – theories of chemical and electrochemical corrosion - mechanism of electrochemical corrosion. Types of corrosion : Galvanic, water-line and pitting corrosion. Factors affecting rate of corrosion. Corrosion control methods – Cathodic protection - sacrificial anode and impressed current cathodic methods. Surface coatings – metallic coatings – methods of application of metallic coatings – Hot dipping , cementation, electroplating of copper - Organic coatings: Paints – their constituents and functions.

**Unit-III: High Polymers :**

Definition – Classification of polymers with examples – Types of polymerisation – Chain growth (free radical addition mechanism), step growth polymerization, coordination polymerization. Plastics, fibres and elastomers - definition and characteristics. Plastics – thermoplastic and thermosetting plastics, constituents of plastics . Fibre reinforced plastics. Preparation, properties and applications of PVC, Teflon, Bakelite, Nylon 6:6 and terylene (Dacron); Rubber – Natural rubber , its processing and vulcanization. Elastomers: Preparation, properties and applications of Styrene butadiene, butyl and thiokol rubbers. Conducting polymers – Classification with examples; mechanism of conduction in trans-polyacetylene and applications of conducting polymers. Biodegradable polymers – concept and advantages - Polylactic acid and polyvinyl acohol and their applications.

**Unit-IV: Chemistry of Energy sources :**

**Fuels** :Classification of fuels - characteristics of a good fuel . Solid fuels: Coal – Analysis of coal by proximate and ultimate methods. Liquid fuels- Petroleum and its refining. Characteristics and uses of petrol, diesel and kerosene. Synthetic petrol- Fischer-Tropsch's process. Cracking – thermal cracking and catalytic cracking. Fluid bed catalytic cracking, Knocking - octane and cetane numbers. Gaseous fuels – Composition, properties and uses of Natural gas, LPG and CNG . Flue gas and its analysis by Orsat's apparatus.

**Combustion** – Definition, calorific value, HCV and LCV. Calculation of air quantity required for combustion of a fuel - Numerical problems.

**Alternate Energy sources** :Biodiesel - trans-esterification - advantages of biodiesel, fuel cells ($H_2$-$O_2$ and Methanol –$O_2$ fuel cell) – Photovoltaic cells.

**Unit-V: Engineering Materials :**

**Cement** – Types of cements- Portland cement and its composition, Setting and hardening of cement. Special Cements – White cement, Water proof cement, high-alumina cement and high early-strength cement .

**Refractories** – Characteristics of a good refractory, classification with examples – refractoriness and refractoriness under load - causes for the failure of refractories.

**Abrasives:** Characteristics – Classification and applications of Diamond and Carborandum (SIC)

**Lubricants** – Characteristics of a good lubricant – mechanism of lubrication – thick film, thin film and extreme pressure lubrication. Classification of lubricants. Properties – viscosity, cloud point, pour point, flash point, fire point and mechanical stability.

**Nanomaterials** : Introduction - Preparation of nanomaterials by top down and bottom up approaches - applications of nanomaterials.

**Text Books:**

1. Engineering Chemistry by P.C.Jain & M.Jain ; Dhanpat Rai Publishing Company (P) Ltd., New Delhi, ($15^{th}$ Edition , 2005).
2. Engineering Chemistry by B.Rama Devi & Ch.Venkata Ramana Reddy ; Cengage Learning , 2012.

**Reference Books :**

1. A Text Book of Engineering Chemistry by Shashi Chawla, Dhanpat Rai & Co., New Delhi.($3^{rd}$ Edition, 2003).
2. Engineering Chemistry by Y. Bharathi Kumari and C. Jyotsna, VGS Booklinks, 2012.
3. Text book of Engineering Chemistry by C P Murthy, C V Agarwal and A. Naidu; B.S.Publications, 2006.
4. Engineering Chemistry by M. Thirumala Chary and E. Lakshminarayana, Sci tech. Publications Pvt. Ltd., Chennai 2012.
5. Engineering Chemistry by B.Sivasankar, Tata McGraw-Hill Publishing Company Ltd., New Delhi 2008.
6. A Text Book of Engineering Chemistry by S.S. Dara, S.Chand Publications, ($10^{th}$ Edition, 2007).

## JNTUH COLLEGE OF ENGINEERING HYDERABAD

**I Year B.Tech. Mech. Engg. I-Sem**

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## COMPUTER PROGRAMMING AND DATA STRUCTURES

**Objectives:**

- To understand the various steps in Program development.
- To understand the basic concepts in C Programming Language.
- To learn how to write modular and readable C Programs
- To understand the basic concepts such as Abstract Data Types, Linear and Non Linear Data structures.
- To understand the notations used to analyze the Performance of algorithms.
- To understand the behavior of data structures such as stacks, queues,
- To understand and analyze various searching and sorting algorithms.
- To write programs in C to solve problems using data structures such as arrays, linked lists,

**UNIT - I**

**Introduction to Computers** – Computer Systems, Computing Environments, Computer Languages, Creating and running programs, Software Development Method, Algorithms, Pseudo code, flow charts, applying the software development method.

**Introduction to C Language** – Background, Simple C programs, Identifiers, Basic data types, Variables, Constants, Input / Output, Operators. Expressions, Precedence and Associatively, Expression Evaluation, Type conversions, Bit wise operators, Statements, Simple C Programming examples.

**Selection Statements** – if and switch statements, Repetition statements – while, for, do-while statements, Loop examples, other statements related to looping – break, continue, go to, Simple C Programming examples.

**UNIT - II**

**Designing Structured Programs**- Functions, basics, user defined functions, inter function communication,

**Standard functions**-Scope, Storage classes-auto, register, static, extern, scope rules, type qualifiers, recursion- recursive functions, Preprocessor commands, example C programs

**Arrays** – Concepts, using arrays in C, inter function communication, array applications, two – dimensional arrays, multidimensional arrays, C program examples.

**UNIT - III**

**Pointers** – Introduction (Basic Concepts), Pointers for inter function communication, pointers to pointers, compatibility, memory allocation functions, array of pointers, programming applications, pointers to void, pointers to functions, command –line arguments.

**Strings** – Concepts, C Strings, String Input / Output functions, arrays of strings, string manipulation functions, string / data conversion, C program examples.

**UNIT - IV**

**Derived types** – Structures – Declaration, definition and initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self referential structures, unions, typedef, bit fields, enumerated types, C programming examples.

**Input and Output** – Concept of a file, streams, standard input / output functions, formatted input / output functions, text files and binary files, file input / output operations, file status functions (error handling), C program examples.

**UNIT – V**

**Sorting**- selection sort, bubble sort, insertion sort,

**Searching**-linear and binary search methods.

**Data Structures** – Introduction to Data Structures, abstract data types, Linear list – singly linked list implementation, insertion, deletion and searching operations on linear list, Stacks-Operations, array and linked representations of stacks, stack applications, Queues-operations, array and linked representations.

**TEXT BOOKS:**

1. C Programming & Data Structures, B.A.Forouzan and R.F. Gilberg, Third Edition, Cengage Learning.
2. Problem Solving and Program Design in C, J.R. Hanly and E.B. Koffman, Fifth Edition, Pearson Education.
3. The C Programming Language, B.W. Kernighan and Dennis M.Ritchie, PHI/Pearson Education

**REFERENCES:**

1. C& Data structures – P. Padmanabham, Third Edition, B.S. Publications.
2. C Programming with problem solving, J.A. Jones & K. Harrow, dreamtech Press
3 Programming in C – Stephen G. Kochan, III Edition, Pearson Eductaion.
4. C for Engineers and Scientists, H.Cheng, Mc.Graw-Hill International Edition
5. Data Structures using C – A.M.Tanenbaum, Y.Langsam, and M.J. Augenstein, Pearson Education / PHI
6. C Programming & Data Structures,E.Balagurusamy,TMH.
7. C Programming & Data Structures, P. Dey, M Ghosh R Thereja, Oxford University Press
8. C& Data structures – E V Prasad and N B Venkateswarlu, S.Chand&Co.

## JNTUH COLLEGE OF ENGINEERING HYDERABAD

**I Year B.Tech. Mech. Engg. I-Sem** **L T P C**

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## ENGINEERING MECHANICS

1. **Introduction to Mechanics** : Basic Concepts, system of Forces Coplanar Concurrent Forces -Components in Space -Resultant -Moment of Forces and its Application - Couples and Resultant of Force Systems. Equilibrium of system of Forces: Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems.
2. **Friction**: Types of friction -Limiting friction -Laws of Friction -static and Dynamic Frictions -Motion of Bodies -Wedge Screw, Screw-jack and differential screw –jack
3. **Centroid and Center of Gravity**: Introduction – Centroids of lines – Centroids of area - Centroids of Composite figures - Theorem of Pappus -Centre of Gravity of Bodies – Centroids of Volumes – Center of gravity of composite bodies.
4. **Area moments of Inertia**: Introduction – Definition of Moment of Inertia -Polar Moment of Inertia – Radius of gyration - Transfer Theorem for moment of inertia – Moments of inertia by integration - Moments of Inertia of Composite Figures, Product of Inertia, Transfer Formula for Product of Inertia.
5. **Mass Moment of Inertia**: Introduction - Moment of Inertia of Masses – Radius of gyration - Transfer Formula for Mass Moments of Inertia – Mass moments of inertia by integration - Mass moment of inertia of composite bodies.

**TEXT BOOKS :**

1. Singer's Engineering Mechanics Statics and Dynamics , K. Vijaya Kumar Reddy, J. Suresh Kumar, BS Publications, 3rd Edition(SI Units)Fifth impression 2013
2. Engg. Mechanics / Timoshenko & Young

**REFERENCES :**

1. Engg. Mechanics/ Irving Shames, G. Krishna Mohan Rao, Prentice Hall
2. Engg. Mechanics Umesh Regl / Tayal.
3. A text of Engineering Mechanics /YVD Rao/ K. Govinda Rajulu/ M. Manzoor Hussain, Academic Publishing Company
4. Text Book in Applied Mechanics / Malhotra, Subramanian, Gahlot and Rathore / New Age.
5. Engg. Mechanics / KL Kumar / Tata McGraw Hill.
6. Engg. Mechanics / M.V. Seshagiri Rao & D Rama Durgaiah.
7. Engg. Mechanics / S.S. Bhavikati & K.G. Rajasekharappa

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## ENGINEERING PHYSICS LAB

**LIST OF EXPERIMENTS**

1. Dispersive power of the material of a prism –Spectrometer
2. Determination of wavelengths of a source-Diffraction Grating.
3. Newton's Rings-Radius of curvature of Plano convex lens.
4. Time constant of an R-C Circuit.
5. Magnetic field along the axis of current carrying coil-Stewart and Gee's method.
6. Bending Losses of Fibers & Evaluation of numerical aperture of given fiber.
7. Energy gap of material of PN- junction.
8. Torsional pendulum.
9. Determination of frequency of A.C Mains-Sonometer.
10. Diffraction grating using single slit- Laser source

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## APPLIED CHEMISTRY LAB

**LIST OF EXPERIMENTS**

1) Estimation of ferrous iron by Permanganometry.
2) Estimation of ferric iron by Dichrometry,
3) Estimation of copper by Iodometry .
4) Estimation of $Fe^{2+}$ & $Fe^{3+}$ by dichrometry.
5) Estimation of hardness of water by Complexometry using EDTA,
6) Estimation of copper by Complexometry using EDTA.
7) Estimation of alkalinity of water.
8) Estimation of Permanent hardness by EDTA
9) Preparation of Thikol rubber .
10) Estimation of iron in cement by Colorimetry; $KMnO_4$
11) Estimation of Mn in $KMnO_4$ by Colorimetry;
12) Estimation of HCl in a given solution by pH - metry.
13) Estimation of HCl in acid mixture by conductometry.
14) Estimation of $Fe^{2+}$ by Potentiometry.

**Recommend Books:**

1. Inorganic Quantitative Analysis by A.I.Vogel, ELBS Publications (2007).
2. Laboratory Manual of Engineering Chemistry by Y. Bharathi Kumari & Jyotsna C, VGS Booklinks, Vijayawada, 2009
3. College Practical Chemistrty by V.K.Ahulwalia., Narosa Publications Ltd., New Delhi (2007)

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## COMPUTER PROGRAMMING AND DATA STRUCTURES LAB

**Objectives:**

- To understand the various steps in Program development.
- To understand the basic concepts in C Programming Language.
- To learn how to write modular and readable C Programs
- To understand the basic concepts such as Abstract Data Types, Linear and Non Linear Data structures.
- To understand the notations used to analyze the Performance of algorithms.
- To understand the behavior of data structures such as stacks, queues,
- To understand and analyze various searching and sorting algorithms.
- To write programs in C to solve problems using data structures such as arrays, linked lists,

**1.** Write a C program to find the sum of individual digits of a positive integer.

**2.** Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1.
Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of the sequence.

**3.** Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.

**4.** Write a C program to find the roots of a quadratic equation.

**6**. Write a C program to find the factorial of a given integer.

**7**. Write a C program to find the GCD (greatest common divisor) of two given integers.

**8**. Write a C program to solve Towers of Hanoi problem.

**9.** Write a C program, which takes two integer operands and one operator from the user, performs the
operation and then prints the result. (Consider the operators +,-,*, /, % and use Switch Statement)

**10.** Write a C program to find both the largest and smallest number in a list of integers.

**11.** Write a C program that uses functions to perform the following:
i) Addition of Two Matrices
ii) Multiplication of Two Matrices

**12.** Write a C program that uses functions to perform the following operations:
i) To insert a sub-string in to a given main string from a given position.
ii) To delete n Characters from a given position in a given string.

**13**. Write a C program to determine if the given string is a palindrome or not

**14.** Write a C program that displays the position or index in the string S where the string T begins, or – 1
if S doesn't contain T.

**15.** Write a C program to count the lines, words and characters in a given text.

**16.** Write a C program to generate Pascal's triangle.

**17.** Write a C program to construct a pyramid of numbers.

**18**. Write a C program that uses functions to perform the following operations:
i) Reading a complex number
ii) Writing a complex number
iii) Addition of two complex numbers
iv) Multiplication of two complex numbers
(Note: represent complex number using a structure.)

**19.** i) Write a C program which copies one file to another.
ii) Write a C program to reverse the first n characters in a file.
(Note: The file name and n are specified on the command line.)

**20.** i) Write a C program to display the contents of a file.
**ii)** Write a C program to merge two files into a third file ( i.e., the contents of the first file followed by those of the second are put in the third file)

**21**. Write a C program that uses functions to perform the following operations on singly linked list.:
i) Creation ii) Insertion iii) Deletion iv) Traversal

**22**. Write C programs that implement stack (its operations) using
i) Arrays ii) Pointers

**23**. Write C programs that implement Queue (its operations) using
i) Arrays ii) Pointers

**24**. Write a C program that implements the following sorting methods to sort a given list of integers in ascending order
i) Bubble sort
ii) Selection sort

**25**. Write C programs that use both recursive and non recursive functions to perform the following searching operations for a Key value in a given list of integers:
i) Linear search ii) Binary search

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### MATHEMATICS-II

**UNIT – I: Linear ODE with variable coefficients and series solutions (second order only)**

Equations reducible to constant coefficients-Cauchy's and Lagrange's differential equations Motivation for series solutions, Ordinary point and Regular singular point of a differential equation , Transformation of non-zero singular point to zero singular point. Series solutions to differential equations around zero, Frobenius Method about zero.

**UNIT-II: Special Functions**

Legendre's Differential equation, General solution of Legendre's equation, Legendre polynomials Properties: Rodrigue's formula – Recurrence relations, Generating function of Legendre's polynomials – Orthogonality.

Bessel's Differential equation, Bessel functions properties: – Recurrence relations, Orthogonality, Generating function, Trigonometric expansions involving Bessel functions.

**UNIT-III: Partial Differential Equations**

Introduction and Formation of partial differential equation by elimination of arbitrary constants and arbitrary functions, solutions of first order linear (Lagrange) equation and non-linear equations (Charpit's method), Method of separation of variables for second order equations –Applications of Partial differential equations-Two dimensional wave equation., Heat equation.

**UNIT –IV: Laplace Transform**

Definition of Integral transform. Domain of the function and Kernel for the Laplace transforms, Laplace transform of standard functions, first shifting Theorem, Laplace transform of functions when they are multiplied or divided by "t". Laplace transforms of derivatives and integrals of functions. – Unit step function – second shifting theorem – Dirac's delta function, Periodic function – Inverse Laplace transform by Partial fractions( Heaviside method) Inverse Laplace transforms of functions when they are multiplied or divided by "s", Inverse Laplace Transforms of derivatives and integrals of functions, Convolution theorem-solving differential equations by Laplace transforms

**UNIT – V: Fourier Series and Fourier Transforms**

Definition of periodic function. Fourier expansion of periodic functions in a given interval of length, $2\pi$ , Determination of Fourier coefficients – Fourier series of even and odd functions – Fourier series in an arbitrary interval – even and odd periodic continuation – Half-range Fourier sine and cosine expansions. Fourier integral theorem – Fourier sine and cosine integrals. Fourier transforms – Fourier sine and cosine transforms – properties – inverse transforms – Finite Fourier transforms.

**TEXT BOOKS:**

1) HIGHER ENGINEERING MATHEMATICS BY B S GREWAL.
2) ADVANCED ENGINEERING MATHEMATICS BY PETER V O'NEIL, CENGAGE LEARNING
3) ENGINEERING MATHEMATICS BY ERWIN KREYSZIG,$10^{TH}$ EDITION WIELY PUBLICATIONS

**REFERENCES:**

1) MATHEMATICS FOR ENGINEERS SERIES- ADVANCED MATHEMATICS FOR ENGINEERS BY K.B.DATTA AND M.A S.SRINIVAS, CENGAGE PUBLICATIONS
2) ADVANCED ENGINEERING MATHEMATICS FOR ENGINEERS BY PROF.A R K PRASAD., WIELY INDIA

3) ADVANCED ENGINEERING MATHEMATICS BY SAHANAZ BATHUL, PHI PUBLICATION
4) ENGINEERING MATHEMATICS-3 BY T.K.V.IYENGAR &B.KRISHNA GANDHI ETC
5) COMPLEX VARIABLES PRINCIPLES AND PROBLEM SESSIONS BY A.K.KAPOOR, WORLD SCIENTIFIC PUBLISHERS
6) A TEXT BOOK OF ENGINEERING MATHEMATICS BY N P BALI, MANESH GOYAL

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## BASIC ELECTRICAL & ELECTRONICS ENGINEERING

**UNIT- I ELECTRICAL and SINGLE PHASE AC CIRCUITS**

**Electrical Circuits -** R-L-C Parameters, Voltage and Current Independent and Dependent Sources, Source Transformation – V–I relationship for Passive elements, Kirchoff's Laws, Network reduction techniques – series, parallel, series parallel, star–to-delta, delta-to-star transformation, Nodal Analysis,

**Single Phase AC Circuits -** R.M.S. and Average values, Form Factor, steady state analysis of series, Parallel and Series parallel Combinations of R, L and C with Sinusoidal excitation, concept of reactance, Impedance, Susceptance and Admittance – phase and phase difference, Concept of Power Factor, j-notation, complex and Polar forms of representation.

**UNIT- II RESONANCE and NETWORK THEOREMS**

**Resonance** – Series resonance and Parallel resonance circuits, concept of bandwidth and Q factor, Locus Diagrams for RL, RC and RLC Combinations for Various Parameters.

**Network Theorems** - Thevenin's, Norton's, Maximum Power Transfer, Superposition, Reciprocity, Tellegen's, Millman's and Compensation theorems for DC and AC excitations.

**UNIT- III P-N JUNCTION DIODE & DIODE CIRCUITS**

**P-N Junction Diode** - Diode equation, Energy Band diagram, Volt-Ampere characteristic, Temperature dependence, Ideal versus practical, Static and dynamic resistances, Equivalent circuit, Load line analysis, Diffusion and Transition Capacitances.

**Rectifiers and Filters -** The P-N junction as a rectifier - A Half Wave Rectifier, Ripple Factor, Full Wave Rectifier, Bridge Rectifier, Harmonic components in Rectifier Circuits, Filters – Inductor Filters, Capacitor Filters, L- section Filters, $\pi$- section Filters.

**UNIT- IV BIPOLAR JUNCTION TRANSISTOR**

**Bipolar Junction Transistor (BJT) -** Construction, Principle of Operation, Symbol, Amplifying Action, Common Emitter, Common Base and Common Collector configurations.

**Transistor Biasing And Stabilization -** Operating point, DC & AC load lines, Biasing - Fixed Bias, Emitter Feedback Bias, Collector to Emitter feedback bias, Voltage divider bias, Bias stability, Stabilization against variations in $V_{BE}$ and $\beta$, Bias Compensation using Diodes and Transistors.

**Transistor Configurations** - BJT modeling, Hybrid model, Determination of h-parameters from transistor characteristics, Analysis of CE, CB and CC configurations using h-parameters, Comparison of CE, CB and CC configurations.

**UNIT- V JUNCTION FIELD EFFECT TRANSISTOR & SPECIAL PURPOSE DEVICES:**

**Junction Field Effect Transistor** - Construction, Principle of Operation, Symbol, Pinch-Off Voltage, Volt-Ampere Characteristic, Comparison of BJT and FET, Small Signal Model, Biasing FET.

**Special Purpose Devices -** Breakdown Mechanisms in Semi Conductor Diodes, Zener diode characteristics, Use of Zener diode as simple regulator Principle of operation and Characteristics of Tunnel Diode (With help of Energy band diagram) and Varactor Diode, Principle of Operation of SCR.

**TEXT BOOKS:**

1. Electronic Devices and Circuits – R.L. Boylestad and Louis Nashelsky, PEI/PHI, 9th Ed, 2006.

2. Millman's Electronic Devices and Circuits – J.Millman and C.C.Halkias, Satyabratajit, TMH, 2/e, 1998.
3. Engineering circuit analysis- by William Hayt and Jack E. Kemmerly, Mc Graw Hill Company, 6th edition.

**REFERENCES:**

1. Introduction to Electronic Devices and Circuits-Rober T. Paynter, Pearson Education.
2. Electronic Devices and Circuits - K. Lal Kishore, B.S. Publications, 2nd Edition, 2005.
3. Electronic Devices and Circuits – Anil K. Maini, Varsha Agarwal –Wiley India Pvt. Ltd. 1/e 2009.
4. Linear circuit analysis (time domain phasor and Laplace transform approaches)- 2nd edition by Raymond A. DeCarlo and Pen-Min-Lin, Oxford University Press-2004.
5. Network Theory by N.C.Jagan & C.Lakshminarayana, B.S. Publications.
6. Network Theory by Sudhakar, Shyam Mohan Palli, TMH.

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## ENGLISH

### 1. INTRODUCTION:

In view of the growing importance of English as a tool for global communication and the consequent emphasis on training students to acquire communicative competence, the syllabus has been designed to develop linguistic and communicative competencies of Engineering students. The prescribed books and the exercises are meant to serve broadly as students' handbooks.

In the English classes, the focus should be on the skills of reading, writing, listening and speaking and for this the teachers should use the text prescribed for detailed study. For example, the students should be encouraged to read the texts/selected paragraphs silently. The teachers can ask comprehension questions to stimulate discussion and based on the discussions students can be made to write short paragraphs/essays etc.

The text for non-detailed study is for extensive reading/reading for pleasure. Hence, it is suggested that they read it on their own the topics selected for discussion in the class. The time should be utilized for working out the exercises given after each section, as also for supplementing the exercises with authentic materials of a similar kind for example, from newspaper articles, advertisements, promotional material etc.. *However, the stress in this syllabus is on skill development, fostering ideas and practice of language skills.*

### 2. OBJECTIVES:

- To improve the language proficiency of the students in English with emphasis on LSRW skills.
- To equip the students to study academic subjects more effectively using the theoretical and practical components of the English syllabus.
- To develop the study skills and communication skills in formal and informal situations.

**Learning Outcomes**

- Usage of correct English Language, written and spoken
- Enrichment of comprehension and fluency
- Gaining Confidence in using language in varied situations

### SYLLABUS:

**Listening Skills:**

**Objectives**

1. To enable students to develop their listening skill so that they may appreciate its role in the LSRW skills approach to language and improve their pronunciation
2. To equip students with necessary training in listening so that they can comprehend the speech of people of different backgrounds and regions

*Students should be given practice in listening to the sounds of the language to be able to recognise them, to distinguish between them to mark stress and recognise and use the right intonation in sentences.*

- Listening for general content
- Listening to fill up information
- Intensive listening
- Listening for specific information

**Speaking Skills:**
**Objectives**

1. To make students aware of the role of speaking in English and its contribution to their success.
2. To enable students to express themselves fluently and appropriately in social and professional contexts.
   - Oral practice
   - Describing objects/situations/people
   - Role play – Individual/Group activities (Using exercises from all the **six** units of the prescribed text: ***Skills Annexe: Functional English for Success*.)**
   - Just A Minute(JAM) Sessions.

**Reading Skills:**
**Objectives**

To develop an awareness in the students about the significance of silent reading and comprehension.

1. To develop the ability of students to guess the meanings of words from context and grasp the overall message of the text, draw inferences etc.
   - Skimming the text
   - Understanding the gist of an argument
   - Identifying the topic sentence
   - Inferring lexical and contextual meaning
   - Understanding discourse features
   - Scanning
   - Recognizing coherence/sequencing of sentences

**NOTE :** *The students will be trained in reading skills using the prescribed text for detailed study.*
*They will be examined in reading and answering questions using 'unseen' passages which may be taken from authentic texts, such as magazines/newspaper articles.*

**Writing Skills:**
**Objectives**

1. To develop an awareness in the students about writing as an exact and formal skill
2. To equip them with the components of different forms of writing, beginning with the lower order ones.

Writing sentences

- Use of appropriate vocabulary
- Paragraph writing
- Coherence and cohesiveness
- Narration / description
- Note Making
- Formal and informal letter writing
- Describing graphs using expressions of comparison

**4. TEXTBOOKS PRESCRIBED:**

In order to improve the proficiency of the student in the acquisition of the four skills mentioned above, the following texts are prescribed:

***For Detailed study***

1. First Text book entitled **"*Skills Annexe -Functional English for Success*",** Published by Orient Black Swan, Hyderabad

2. The Second Textbook entitled ***"Epitome of Wisdom",*** published by Maruthi Publications, Hyderabad.

The course content and study material is divided into **Five Units.**

**Unit –I:**

1. Chapter entitled '***Wit and Humour'*** from 'Skills Annexe' -Functional English to Success Published by Orient Black Swan, Hyderabad
2. Chapter entitled ***'Mokshagundam Visvesvaraya'*** from *"Epitome of Wisdom",* Published by Maruthi Publications, Hyderabad.

**and**

L-Listening For Sounds, Stress and Intonation
S-Greeting and Taking Leave, Introducing Oneself and Others (Formal and Informal Situations)
R- Reading for Subject/ Theme
W- Writing Paragraphs
G-Types of Nouns and Pronouns
V- Homonyms, homophones synonyms, antonyms

**Unit –II**

1. Chapter entitled "***Advances in Science and Technology"*** from "***Skills Annexe - Functional English for Success***" Published by Orient Black Swan, Hyderabad.

2. Chapter entitled ***'Three days To See'*** from ***"Epitome of Wisdom",*** Published by Maruthi Publications, Hyderabad.

**and**

L – Listening for themes and facts
S – Apologizing, interrupting, requesting and making polite conversation
R- for theme and gist
W- Describing people, places, objects, events
G- Verb forms
V- Noun, verb, adjective and adverb

**Unit –III**

1. Chapter entitled ***'Risk Management'*** from ***"Skills Annexe -Functional English for Success"*** Published by Orient Black Swan, Hyderabad
2. Chapter entitled ***'Leela's Friend'*** by R.K. Narayan from ***"Epitome of Wisdom",*** Published by Maruthi Publications, Hyderabad

**And**

L – for main points and sub-points for note taking
S – Giving instructions and directions; Speaking of hypothetical situations
R – Reading for details
W – Note-making, information transfer, punctuation
G – Present tense
V – Synonyms and Antonyms

**Unit –IV**

1. Chapter entitled '***Human Values and Professional Ethics'*** from "***Skills Annexe - Functional English for Success"*** Published by Orient Black Swan, Hyderabad
2. Chapter entitled ***'The Last Leaf'*** from ***"Epitome of Wisdom",*** Published by Maruthi Publications, Hyderabad

and

L -Listening for specific details and information
S- Narrating, expressing opinions and telephone interactions
R -Reading for specific details and information
W- Writing formal letters and CVs
G- Past and future tenses
V- Vocabulary - idioms and Phrasal verbs

**Unit –V**

1. Chapter entitled '***Sports and Health'*** from ***"Skills Annexe -Functional English for Success***" Published by Orient Black Swan, Hyderabad
2. Chapter entitled ***'The Convocation Speech'*** by N.R. Narayanmurthy' from ***"Epitome of Wisdom",*** Published by Maruthi Publications, Hyderabad

**and**

L- Critical Listening and Listening for speaker's tone/ attitude
S- Group discussion and Making presentations
R- Critical reading, reading for reference
W-Project proposals; Technical reports, Project Reports and Research Papers
G- Adjectives, prepositions and concord
V- Collocations and Technical vocabulary and using words appropriately

* Exercises from the texts not prescribed shall also be used for classroom tasks.

**SUGGESTED READING:**


1. ***Contemporary English Grammar Structures and Composition*** by David Green, MacMillan Publishers, New Delhi. 2010.
2. **Innovate with English: A Course in English for Engineering Students,** edited by T Samson, Foundation Books.
3. English Grammar Practice**, Raj N Bakshi, Orient Longman.**
4. **Technical Communication** by Daniel Riordan. 2011. **Cengage Publications. New Delhi.**
5. **Effective English, edited** by E Suresh Kumar, A RamaKrishna Rao, P Sreehari, Published by **Pearson**
6. Handbook of English Grammar& Usage**, Mark Lester and Larry Beason, Tata Mc Graw –Hill.**
7. Spoken English**, R.K. Bansal & JB Harrison, Orient Longman.**
8. Technical Communication, **Meenakshi Raman, Oxford University Press**
9. Objective English **Edgar Thorpe & Showick Thorpe**, **Pearson Education**
10. Grammar Games**, Renuvolcuri Mario, Cambridge University Press.**
11. Murphy's English Grammar with CD**, Murphy, Cambridge University Press.**
12. Everyday Dialogues in English**, Robert J. Dixson, Prentice Hall India Pvt Ltd.,**
13. ABC of Common Errors **Nigel D Turton, Mac Millan Publishers.**
14. Basic Vocabulary **Edgar Thorpe & Showick Thorpe**, **Pearson Education**
15. Effective Technical Communication**, M Ashraf Rizvi, Tata Mc Graw –Hill.**
16. An Interactive Grammar of Modern English, **Shivendra K.Verma and Hemlatha Nagarajan, Frank Bros & CO**
17. A Communicative Grammar of English, **Geoffrey Leech, Jan Svartvik, Pearson Education**
18. Enrich your English, **Thakur K B P Sinha, Vijay Nicole Imprints Pvt Ltd.,**
19. A Grammar Book for You And I, **C. Edward Good, MacMillan Publishers.**

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## ENGINEERING GRAPHICS

**Pre-requisite: Nil**

**Objective**: The objective of this subject is to provide the basic concepts about Engineering Drawing. Detailed concepts are given in projections, technical drawing, dimensioning and specifications.
**Codes / Tables**: Nil

**Question Paper Pattern**:
5 Questions to be answered out of 8 questions.
Each question should not have more than 3 bits.

**UNIT – I**
**INTRODUCTION TO ENGINEERING DRAWING :**
Principles of Engineering Graphics and their Significance, Conic Sections including the Rectangular Hyperbola – General method only. Cycloid, Epicycloid and Hypocycloid, Involute. Scales – Plain, Diagonal and Vernier Scales.

**UNIT- II**
**ORTHOGRAPHIC PROJECTIONS:**
Principles of Orthographic Projections – Conventions – Projections of Points and Lines Projections of Plane regular geometric figures.—Auxiliary Planes.

**UNIT – III**
Projections of Regular Solids – Auxiliary Views.

**UNIT – IV**
Sections or Sectional views of Right Regular Solids – Prism, Cylinder, Pyramid, Cone – Auxiliary views – Sections of Sphere.
Development of Surfaces of Right Regular Solids – Prism, Cylinder, Pyramid and Cone

**UNIT – V**
**ISOMETRIC PROJECTIONS :**
Principles of Isometric Projection – Isometric Scale – Isometric Views – Conventions – Isometric Views of Lines, Plane Figures, Simple and Compound Solids – Isometric Projection of objects having non- isometric lines. Isometric Projection of Spherical Parts.
Conversion of Isometric Views to Orthographic Views and Vice-versa – Conventions

**TEXT BOOKS :**
1. Engineering Drawing N.D. Bhatt / Charotar
2. Engineering Drawing and Graphics Rane and Shah/ Pearson Edu.

**REFERENCE BOOKS**:
1. A Text Book of Engineering Drawing / Dhawan R K / S. Chand
2. Engineering Graphics With Auto CAD / James D Bethune / Pearson Edu.
3. Engineering Graphics / K R Mohan / Dhanpat Rai.
4. Text book on Engineering Drawing / KL Narayana/ P Kannaih / Scitech

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## ENVIRONMENTAL SCIENCE

**UNIT - I**

**MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES:** Definition, Scope and Importance – Need for Public Awareness.

**NATURAL RESOURCES :** Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems - Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. - Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. - Energy resources: Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources. Case studies. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

**UNIT - II**

**ECOSYSTEMS :** Concept of an ecosystem. - Structure and function of an ecosystem. - Producers, consumers and decomposers. - Energy flow in the ecosystem - Ecological succession. - Food chains, food webs and ecological pyramids. - Introduction, types, characteristic features, structure and function of the following ecosystem:

a. Forest ecosystem
b. Grassland ecosystem
c. Desert ecosystem
d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

**UNIT - III**

**BIODIVERSITY AND ITS CONSERVATION :** Introduction - Definition: genetic, species andecosystem diversity. - Bio-geographical classification of India - Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - . Biodiversity at global, National and local levels. - . India as a mega-diversity nation - Hot-sports of biodiversity - Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. - Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

**UNIT - IV**

**ENVIRONMENTAL POLLUTION:** Definition, Cause, effects and control measures of :

a. Air pollution
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. Nuclear hazards

**SOLID WASTE MANAGEMENT:** Causes, effects and control measures of urban and

industrial wastes. - Role of an individual in prevention of pollution. - Pollution case studies. - Disaster management: floods, earthquake, cyclone and landslides.

**UNIT - V**

**SOCIAL ISSUES AND THE ENVIRONMENT :** From Unsustainable to Sustainable development -Urban problems related to energy -Water conservation, rain water harvesting, watershed management -Resettlement and rehabilitation of people; its problems and concerns. Case Studies -Environmental ethics: Issues and possible solutions. -Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies. -Wasteland reclamation. –Consumerism and waste products. -Environment Protection Act. -Air (Prevention and Control of Pollution) Act. -Water (Prevention and control of Pollution) Act -Wildlife Protection Act -Forest Conservation Act -Issues involved in enforcement of environmental legislation. -Public awareness.

**HUMAN POPULATION AND THE ENVIRONMENT:** Population growth, variation among nations. Population explosion - Family Welfare Programme. -Environment and human health. -Human Rights. -Value Education. -HIV/AIDS. -Women and Child Welfare. -Role of information Technology in Environment and human health. –Case Studies.

**FIELD WORK :** Visit to a local area to document environmental assets River /forest grassland/hill/mountain -Visit to a local polluted site-Urban/Rural/industrial/ Agricultural Study of common plants, insects, birds. -Study of simple cosystemspond, river, hill slopes, etc.

**TEXT BOOK:**

1 Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission.,UniversitiesPress
2 Environmental Studies by R. Rajagopalan, Oxford University Press.

**REFERENCE:**

1. Textbook of Environmental Sciences and Technology by M. Anji Reddy, BS Publication.

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## COMPUTATIONAL MATHEMATICS

**UNIT-I: Matrices and Linear Transformations:**

Real matrices – Symmetric, skew – symmetric, orthogonal. Complex matrices: Hermitian, Skew-Hermitian and Unitary Matrices. Idempotent matrix,

Finding rank of a matrix by reducing to Echelon and Normal forms .

Consistency of system of linear equations (homogeneous and non- homogeneous) using the rank of a matrix – Solving Linear System of equations, (number of equations and unknowns need not be same).Check the uniqness of solutions.

Cayley-Hamilton Theorem (without Proof) – Verification. Finding inverse of a matrix and powers of a matrix by Cayley-Hamilton theorem, Linear dependence and Independence of Vectors. Linear Transformation – Orthogonal Transformation. Eigen values and Eigen vectors of a matrix. Finding linearly independent Eigen vectors of a matrix when the Eigen values of the matrix are repeated. Properties of Eigen values and Eigen vectors of matrices.

Diagonolization of matrix – Quadratic forms upto three variables- Reduction of quadratic form to canonical form, Rank – Positive definite, negative definite – semi definite – index – signature of quadratic form.

**UNIT – II: Interpolation and Curve fitting :**

**Interpolation:** Introduction- Errors in Polynomial Interpolation – Finite differences- Forward Differences- Backward differences –Central differences – Symbolic relations and separation of symbols- Difference Equations – Differences of a polynomial-Newton's formulae for interpolation – Central difference interpolation Formulae – Gauss Central Difference Formulae –Interpolation with unevenly spaced points-Lagrange's Interpolation formula.

**Curve fitting**: Fitting a straight line –Second degree curve-exponential curve-power curve by method of least squares.

**UNIT – III : Numerical techniques :**

**Solution of Algebraic and Transcendental Equations and Linear system of equations.**

Introduction – Graphical interpretation of solution of equations .The Bisection Method – The Method of False Position – The Iteration Method – Newton-Raphson Method .

Solving system of non-homogeneous equations by L-U Decomposition method(Crout's Method)Jacobi's and Gauss-Seidel Iteration method

**UNIT- IV: Numerical Differentiation, Integration, and Numerical solutions of First order differential equations:**

Numerical differentiation, Numerical integration – Trapezoidal rule, Simpson's $1/3^{rd}$ and 3/8 Rule , Generalized Quadrature.

**UNIT – V:**

Numerical solution of Ordinary Differential equations: Solution by Taylor's series method – Picard's Method of successive Approximation- single step methods-Euler's Method-Euler's modified method, Runge-Kutta Methods.

**Text Books:**

1) INTRODUCTORY METHODS OF NUMERICAL ANALYSIS BY SS SASTRY
2) NUMERICAL AND STATISTICAL METHODS WITH PROGRAMMING IN C BY SUJATHA SINHA AND SUBHABRADA DINDA, SCITEC PUBLISHERS

**References:**

1) ADVANCED ENGINEERING MATHEMATICS BY ALAN JEFFERY
2) APPLIED NUMERICAL METHODS USING MATLAB BY RAO.V.DUKKIPATI,NEW AGE PUBLISHERS
3) NUMERICAL METHODS IN SCIENCE AND ENGINEERING –APRACTICAL APPROACH BY S.RAJASEKHARAN, S.CHAND PUBLICATIONS

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## ENGINEERING WORKSHOP

I. TRADES FOR EXERCISES :
(Any **six** trades from the following with minimum of **two** exercises in each trade)

1. Carpentry
2. Fitting
3. Tin-Smithy
4. Black Smithy
5. House-wiring
6. Foundry
7. Plumbing

II. Trades for Demonstration & Exposure

1. Demonstration of power tools & wiring
2. Welding
3. Machine Shop

III. **IT Workshop I:** Computer hardware, identification of parts, Disassembly, Assembly of computer to working condition, simple diagnostic exercises.
**IT Workshop II:** Installation of operating system windows and linux simple diagnostic exercises.

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## ENGLISH LANGUAGE COMMUNICATION SKILLS LAB

The **Language Lab** focuses on the production and practice of sounds of language and familiarises the students with the use of English in everyday situations and contexts.

**Objectives**

- To facilitate computer-aided multi-media instruction enabling individualized and independent language learning
- To sensitise the students to the nuances of English speech sounds, word accent, intonation and rhythm
- To bring about a consistent accent and intelligibility in their pronunciation of English by providing an opportunity for practice in speaking
- To improve the fluency in spoken English and neutralize mother tongue influence
- To train students to use language appropriately for interviews, group discussion and public speaking

**Learning Outcomes**

- Better Understanding of nuances of language through audio- visual experience and group activities
- Neutralization of accent for intelligibility
- Speaking with clarity and confidence thereby enhancing employability skills of the students

**Syllabus:**

**English Language Communication Skills Lab shall have two parts:**

a. **Computer Assisted Language Learning (CALL) Lab**
b. **Interactive Communication Skills (ICS) Lab**

The following course content is prescribed for the **English Language Communication Skills Lab**

**Exercise – I**

**CALL Lab**: Introduction to Phonetics – Speech Sounds – Vowels and Consonants
**ICS Lab**: Ice-Breaking activity and JAM session
Articles, Prepositions, Word Formation- Prefixes & Suffixes, Synonyms & Antonyms

**Exercise – II**

**CALL Lab**: Structure of Syllables - Past Tense Marker and Plural Marker – Weak Forms and Strong Forms - Consonant Clusters.
**ICS Lab**: Situational Dialogues – Role-Play- Expressions in Various Situations – Self-introduction and Introducing Others – Greetings – Apologies – Requests – Social and Professional Etiquette - Telephone Etiquette.
Concord (Subject in agreement with verb) and Words often misspelt- confused/misused

**Exercise - III**

**CALL Lab:** Minimal Pairs- Word Accent and Stress Shifts- Listening Comprehension.
**ICS Lab**: Descriptions- Narrations- Giving Directions and Guidelines.
Sequence of Tenses, Question Tags and One Word Substitutes.

**Exercise – IV**
**CALL Lab**: Intonation and Common errors in Pronunciation.
**ICS Lab**: Extempore- Public Speaking
Active and Passive Voice, –Common Errors in English, Idioms and Phrases

**Exercise – V**
**CALL Lab:** Neutralization of Mother Tongue Influence and Conversation Practice
**ICS Lab**: Information Transfer- Oral Presentation Skills
Reading Comprehension and Job Application with Resume preparation.

**Minimum Requirement of infrastructural facilities for ELCS Lab:**

**1. Computer Assisted Language Learning (CALL) Lab:**

**The Computer Aided Language Lab** for 40 students with 40 systems, one master console, LAN facility and English language software for self- study by learners.

**System Requirement (Hardware component):**
*Computer network with Lan with minimum 60 multimedia systems with the following specifications:*

i) P – IV Processor
   a) Speed – 2.8 GHZ
   b) RAM – 512 MB Minimum
   c) Hard Disk – 80 GB
ii) Headphones of High quality

**2. Interactive Communication Skills (ICS) Lab :**

**The Interactive Communication Skills Lab:** A Spacious room with movable chairs and audio-visual aids with a Public Address System, a T. V., a digital stereo –audio & video system and camcorder etc.

**Prescribed Lab Manual:** A Manual entitled "***English Language Communication Skills (ELCS) Lab Manual- cum- Work Book***", published by Cengage Learning India Pvt. Ltd, New Delhi. 2013.

- *In addition to the prescribed lab manual, all the listening and speaking activities mentioned in Text-1 and Text-2 can be conducted in the English Language Communication Skills Lab.*

**Suggested Software:**
- **Cambridge Advanced Learners' English Dictionary with CD.**
- **Grammar Made Easy by Darling Kindersley**
- **Punctuation Made Easy by Darling Kindersley**
- Clarity Pronunciation Power – Part I
- Clarity Pronunciation Power – part II
- **Oxford Advanced Learner's Compass, 8th Edition**
- ***DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice.***
- Lingua TOEFL CBT Insider, by Dreamtech
- TOEFL & GRE (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)
- **English in Mind (Series 1-4), Herbert Puchta and Jeff Stranks with Meredith Levy, Cambridge**

- **English Pronunciation in Use** (Elementary, Intermediate, Advanced) Cambridge University Press
- Raman, M & Sharma, S. 2011. Technical Communication, OUP
- Sanjay Kumar & Pushp Lata. 2011. Communication Skills, OUP

**SUGGESTED READING:**


1. Rama Krishna Rao, A. *et al. English Language Communication Skills – A Reader cum Lab Manual Course Content and Practice.* Chennai: Anuradha Publishers
2. Suresh Kumar, E. & Sreehari, P. 2009. *A Handbook for English Language Laboratories.* New Delhi: Foundation
3. *Speaking English Effectively* 2nd Edition by Krishna Mohan and N. P. Singh, 2011. Macmillan Publishers India Ltd. Delhi.
4. Sasi Kumar, V & Dhamija, P.V. *How to Prepare for Group Discussion and Interviews.* Tata McGraw Hill
5. Hancock, M. 2009. *English Pronunciation in Use. Intermediate.* Cambridge: CUP
6. Spoken English: A Manual of Speech and Phonetics by R. K. Bansal & J. B. Harrison. 2013. Orient Blackswan. Hyderabad.
7. Hewings, M. 2009. *English Pronunciation in Use. Advanced.* Cambridge: CUP
8. Marks, J. 2009. *English Pronunciation in Use. Elementary.* Cambridge: CUP
9. Nambiar, K.C. 2011. *Speaking Accurately. A Course in International Communication.* New Delhi : Foundation
10. Soundararaj, Francis. 2012. *Basics of Communication in English. New Delhi: Macmillan*
11. *Spoken English* (CIEFL) in 3 volumes with 6 cassettes, OUP.
12. *English Pronouncing Dictionary* Daniel Jones Current Edition with CD.
13. *A Textbook of English Phonetics for Indian Students* by T.Balasubramanian (Macmillan)


**DISTRIBUTION AND WEIGHTAGE OF MARKS**

***English Language Laboratory Practical Examination:***

1) The practical examinations for the English Language Laboratory shall be conducted as per the University norms prescribed for the core engineering practical sessions.
2) For the Language lab sessions, there shall be a continuous evaluation during the year for 25 sessional marks and 50 year-end Examination marks. Of the 25 marks, 15 marks shall be awarded for day-to-day work and 10 marks to be awarded by conducting Internal Lab Test(s). The year- end Examination shall be conducted by the teacher concerned with the help of another member of the staff of the same department of the same institution.

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**COMPUTATIONAL MATHEMATICS LAB**

**Interpolation:Programming Tasks**:

1. A) Write a C program to determine y for a given x, if two arrays of x and y of same size are given.(using Newton's interpolation both forward and backward)
   B) Write a C program to determine y for a given x, if two arrays of x and y of same size are given.(using Lagrange 's interpolation)
   C) Write a C program to determine y for a given x, if two arrays of x and y of same size are given.(using Gauss interpolation)
   (Selection criteria of the interpolation formula are important.)

**Curve fitting**:**Programming Tasks:**

2. A) Write a C program to find a line of best fit from the given two arrays of x and y of same size.
   B) Write a C program to find a curve of the form $y = Ae^{Bx}$ from the given two arrays of x and y of same size.
   C) Write a C program to find a curve of the form $y = Ax^B$ from the given two arrays of x and y of same size.
   D) Write a C program to find a curve of the form $y = Ax^2 + Bx + C$ from the given two arrays of x and y of same size.

**Solution of Algebraic and Transcendental EquationsProgramming Tasks:**

3. A) Write a C program to find the root of a given equation using bisection method. (Write this program such that the initial values given to the system are not usable, then the system should ask us to give new set of initial values)
   B) Write a C program to find the root of a given equation using method of false position(regula false position)
   C) Write a C program to find the root of a given equation using iteration method
   D) Write a C program to find the root of a given equation using Newton Rophson method

**Linear system of equationsProgramming Tasks:**

4. A) Write a C program to find the solution of given system of linear equations using L- U decomposition method
   B) Write a C program to find the solution of given system of linear equations using jacobi's method
   C) Write a C program to find the solution of given system of equations using Gauss sidel iteration method
   D) Write a C program to find the solution of given system of equations using Gauss Jordan elimination method

**Numerical Differentiation, Integration, and Numerical solutions of First order differential equations:**

**Programming Tasks:**

5. A) Write a C program to evaluate definite integral using trapezoidal rule, Simpson's $1/3^{rd}$ rule and $3/8^{th}$ rule.
   B) Write a C program to solve a given differential equation using Taylor's series
   C) Write a C program to solve a given differential equation Euler's and modified Eulers method
   D) Write a C program to solve a given differential equation using Ruge-Kutta method.

**Text Books:**

1) INTRODUCTORY METHODS OF NUMERICAL ANALYSIS BY SS SASTRY
2) NUMERICAL AND STATISTICAL METHODS WITH PROGRAMMING IN C BY SUJATHA SINHA AND SUBHABRADA DINDA, SCITEC PUBLISHERS

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2) APPLIED NUMERICAL METHODS USING MATLAB BY RAO.V.DUKKIPATI,NEW AGE PUBLISHERS
3) NUMERICAL METHODS IN SCIENCE AND ENGINEERING –APRACTICAL APPROACH BY S.RAJASEKHARAN, S.CHAND PUBLICATIONS

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## MATHEMATICS – III

**UNIT-I: Single Random variables and probability distributions.**

Random variables – Discrete and continuous. Probability distributions, mass function/ density function of a probability distribution. Mathematical Expectation, Moment about origin, Central moments Moment generating function of probability distribution.

Binomial , Poisson & normal distributions and their properties . Moment generating functions of the above three distributions. and hence finding the mean and variance.

**UNIT-II: Multiple Random variables, Correlation & Regression**

Joint probability distributions- Joint probability mass / density function, Marginal probability mass / density functions, Covariance of two random variables, Correlation -Coefficient of correlation, The rank correlation.

Regression- Regression Coefficient, The lines of regression and multiple correlation & regression.

**UNIT-III: Sampling Distributions and Testing of Hypothesis**

**Sampling:** Definitions of population, sampling, statistic, parameter. Types of sampling, Expected values of Sample mean and varience, sampling distribution, Standard error, Sampling distribution of means and sampling distribution of varience.

**Parameter estimations** – likelihood estimate, interval estimations .

**Testing of hypothesis**: Null hypothesis, Alternate hypothesis, type I, & type II errors – critical region, confidence interval, Level of significance. One sided test, Two sided test,

**Large sample tests:**

(i) Test of Equality of means of two samples equality of sample mean and population mean (cases of known varience & unknown varience, equal and unequal variances)

(ii) Tests of significance of difference between sample S.D and population S.D.

(iii) Tests of significance difference between sample proportion and population proportion & difference between two sample proportions.

**Small sample tests:**

Student t-distribution,its properties; Test of significance difference between sample mean and population mean; difference between means of two small samples

Snedecor's F- distribution and it's properties. Test of equality of two population variences

Chi-square distribution , it's properties, Chi-square test of goodness of fit.

**UNIT-IV: Functions of Complex Variables**

Complex functions and its representation on Argand plane, Concepts of limit Continuity, Differentiability, Analyticity, Cauchy-Riemann conditions, Harmonic functions – Milne – Thompson method.

Line integral – Evaluation along a path and by indefinite integration – Cauchy's integral theorem – Cauchy's integral formula – Generalized integral formula.

Radius of convergence – Expansion in Taylor's series, Maclaurin's series and Laurent series. Singular point –Isolated singular point – pole of order m – essential singularity

**UNIT – V: Contour Integration**

Residue – Evaluation of residue by formula and by Laurent series – Residue theorem.

Evaluation of integrals of the type

(a) Improper real integrals $\int_{-\infty}^{\infty} f(x)dx$ (b) $\int_{c}^{c+2\pi} f(\cos\theta, \sin\theta)d\theta$

**Conformal mapping.**

Transformation of z-plane to w-plane by a function, Conformal transformation. Standard transformations- Translation; Magnification and rotation; inversion and reflection, Transformations like $e^z$, log z, $z^2$, and Bilinear transformation. Properties of Bilinear transformation, determination of bilinear transformation when mappings of 3 points are given .

**Text Books:**


1) FUNDAMENTALS OF MATHEMATICAL STATISTICS BY S C GUPTA AND V.K.KAPOOR
2) PROBABILITY AND STATISTICS FOR ENGINEERS AND SCIENTISTS BY SHELDON M.ROSS,ACADEMIC PRESS
3) PROBABILITY AND STATISTICS FOR ENGINEERING AND THE SCIENCEC BY JAY L.DEVORE.
4) HIGHER ENGINEERING MATHEMATICS BY B S GREWAL.
5) ADVANCED ENGINEERING MATHEMATICS BY PETER V O'NEIL, CENGAGE LEARNING
6) ENGINEERING MATHEMATICS BY ERWIN KREYSZIG,$10^{TH}$ EDITION WIELY PUBLICATIONS


**References:**


1) MATHEMATICS FOR ENGINEERS SERIES –PROBABILITY STATISTICS AND STOCHASTIC PROCESS BY K.B.DATTA AND M.A S.SRINIVAS,CENGAGE PUBLICATIONS
2) PROBABILITY, STATISTICS AND STOCHASTIC PROCESS BY PROF.A R K PRASAD., WIELY INDIA
3) ADVANCED ENGINEERING MATHEMATICS BY SAHANAZ BATHUL, PHI PUBLICATION
4) PROBABILITY AND STATISTICS BY T.K.V.IYENGAR &B.KRISHNA GANDHI etel
5) MATHEMATICS FOR ENGINEERS SERIES- ADVANCED MATHEMATICS FOR ENGINEERS BY K.B.DATTA AND M.A S.SRINIVAS, CENGAGE PUBLICATIONS
6) ADVANCED ENGINEERING MATHEMATICS FOR ENGINEERS BY PROF.A R K PRASAD., WIELY INDIA

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## METALLURGY AND MATERIAL SCIENCE

**UNIT – I**

Structure of Metals : Bonds in Solids – Metallic bond - crystallization of metals, grain and grain boundaries, effect of grain boundaries on the properties of metal / alloys – determination of grain size.

Constitution of Alloys : Necessity of alloying, types of solid solutions, Hume Rotherys rules, intermediate alloy phases, and electron compounds.

**UNIT -II**

Equilibrium of Diagrams : Experimental methods of construction of equilibrium diagrams, Isomorphous alloy systems, equilibrium cooling and heating of alloys, Lever rule, coring miscibility gaps, eutectic systems, congruent melting intermediate phases, peritectic reaction. Transformations in the solid state – allotropy, eutectoid, peritectoid reactions, phase rule, relationship between equilibrium diagrams and properties of alloys. Study of important binary phase diagrams of Cu-Ni-, Al-Cu, Bi-Cd, Cu-An, Cu-Sn and Fe-$Fe_3C$.

**UNIT -III**

Cast Irons and Steels : Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheroidal graphite cast iron, Alloy cast irons. Classification of steels, structure and properties of plan carbon steels, Low alloy steels, Hadfield manganese steels, tool and die steels.

**UNIT – IV**

Heat treatment of Alloys : Effect of alloying elements on Fe-Fe3C system, Annealing, normalizing, Hardening, TTT diagrams, tempering , Hardenability surface - hardening methods, Age hardening treatment, Cryogenic treatment of alloys.

Non-ferrous Metals and Alloys : Structure and properties of copper and its alloys, Aluminium and its alloys, Titanium and its alloys.

**UNIT – V**

Ceramic materials : Crystalline ceramics, glasses, cermaets, abrasive materials, nonomaterials – definition, properties and applications of the above.

Composite materials : Classification of composites, various methods of component manufacture of composites, particle – reinforced materials, fiber reinforced materials, metal ceramic mixtures, metal – matrix composites and C – C composites.

**TEXT BOOKS :**

1. Introduction to Physical Metallurgy / Sidney H. Avener.
2. Material science & Metallurgy / Kodgire

**REFERENCE BOOKS :**

1. Science of Engineering Materials / Agarwal
2. Materials Science / Vijendra Singh
3. Elements of Material science / V. Rahghavan
4. An introduction to material science / W.g.vinas & HL Mancini
5. Material science & material / C.D.Yesudian & harris Samuel
6. Engineering Materials and Their Applications – R. A Flinn and P K Trojan / Jaico Books.

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## MECHANICS OF SOLIDS

**UNIT-I**

**SIMPLE STRESSES AND STRAINS :** Elasticity and plasticity – Types of stresses and strains – Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio and volumetric strain – Elastic moduli and the relationship between them – Bars of varying section – composite bars – Temperature stresses. Strain energy – Resilience – Gradual, sudden, impact and shock loadings.

**Unit-II**

**SHEAR FORCE AND BENDING MOMENT :** Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilver, simply supported and overhanging beams subjected to point loads , u.d.l, uniformly varying loads and combination of these loads – Point of contraflexure – Relation between S.F., B.M and rate of loading at a section of a beam.

**UNIT-III**

**FLEXURAL STRESSES :**

Theory of simple bending – Assumptions Derivation of bending equation : M/I=f/y=E/R Neutral axis – Determination bending stresses – section modules of rectangular and circular sections (Solid and Hollow), I,T,Angle and Channel sections – Design of simple beam sections.

Shear Stresses : Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I, T angle sections.

**UNIT-IV**

**ANALYSIS OF PIN-JOINTED PLANE FRAMES :** Determination of Forces in members of plane, pin-joined, perfect trusses by (i) method of joints and (ii) method of sections. Analysis of various types of cantilever and simply – supported trusses – by method of joints, method of sections and tension coefficient methods.

**DEFLECTION OF BEAMS :** Bending into a circular arc – slope, deflection and radius of curvature – Differential equation for the elastic line of a beam – Double integration and Macaulay's methods – Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, - U.D.L. uniformly varying load. Mohr's theorems – Moment area method – application to simple cases including overhanging beams.

**Unit-V**

**THIN CYLINDERS :** Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and Volumetric strains – changes in dia, and volume of thin cylinders – Riveted boiler shells – Thin spherical shells.

**Thick Cylinders** – lame's equation – cylinders subjected to inside and out side pressures – compound cylinders.

**TEXT BOOKS :**

1. Strength of Materials by Andrew Pytel and Ferdinond L. Singer Longman
2. Strength of Materials by Jondar : Galgotia Publications

**REFERENCES :**

1. Strength of Materials by Bansal, Lakshmi Publications
2. Strenght of Mateirals by S. Tumoshenko
3. Strength of Materials by R.S. Khurmi; S. Chand & Co. 2005

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## THERMODYNAMICS

**UNIT – I**

**Introduction: Basic Concepts:**

System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Exact & Inexact Differentials, Cycle – Reversibility – Quasi – static Process, Irreversible Process, Causes of Irreversibility – Energy in State and in Transition, Types, Displacement & Other forms of Work, Heat, Point and Path functions, Zeroth Law of Thermodynamics – Concept of Temperature – Principles of Thermometry – Reference Points – Const. Volume gas Thermometer – Scales of Temperature, Ideal Gas Scale

**UNIT II**

PMM I - Joule's Experiments – First law of Thermodynamics – Corollaries – First law applied to a Process – applied to a flow system – Steady Flow Energy Equation.

Limitations of the First Law – Thermal Reservoir, Heat Engine, Heat pump , Parameters of performance, Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their Equivalence / Corollaries, PMM of Second kind, Carnot's principle, Carnot cycle and its specialties, Thermodynamic scale of Temperature, Clausius Inequality, Entropy, Principle of Entropy Increase – Energy Equation, Availability and Irreversibility – Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the Third Law of Thermodynamics

**UNIT – III**

Pure Substances, p-V-T- surfaces, T-S and h-s diagrams, Mollier Charts, Phase Transformations – Triple point at critical state properties during change of phase, Dryness Fraction – Clausius – Clapeyron Equation Property tables. Mollier charts – Various Thermodynamic processes and energy Transfer – Steam Calorimetry.

Perfect Gas Laws – Equation of State, specific and Universal Gas constants – various Non-flow processes, properties, end states, Heat and Work Transfer, changes in Internal Energy – Throttling and Free Expansion Processes – Flow processes

**UNIT IV**

Deviations from perfect Gas Model – Vader Waals Equation of State – Compressibility charts – variable specific Heats – Gas Tables

Mixtures of perfect Gases – Mole Fraction, Mass friction Gravimetric and volumetric Analysis – Dalton's Law of partial pressure, Avogadro's Laws of additive volumes – Mole fraction , Volume fraction and partial pressure, Equivalent Gas const. And Molecular Internal Energy, Enthalpy, sp. Heats and Entropy of Mixture of perfect Gases and Vapour, Atmospheric air - Psychrometric Properties – Dry bulb Temperature, Wet Bulb Temperature, Dew point Temperature, Thermodynamic Wet Bulb Temperature, Specific Humidity, Relative Humidity, saturated Air, Vapour pressure, Degree of saturation – Adiabatic Saturation , Carrier's Equation – Psychrometric chart.

**UNIT - V**

**Power Cycles :** Otto, Diesel, Dual Combustion cycles, Sterling Cycle, Atkinson Cycle, Ericsson Cycle, Lenoir Cycle – Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles.

**Refrigeration Cycles:**

Brayton and Rankine cycles – Performance Evaluation – combined cycles, Bell-Coleman cycle, Vapour compression cycle-performance Evaluation.

**TEXT BOOKS :**

1. Engineering Thermodynamics / PK Nag /TMH, III Edition

2. Thermodynamics / C.P.Arora.

**REFERENCE BOOKS:**

1. Thermodynamics – An Engineering Approach – Yunus Cengel & Boles /TMH
2. Fundamentals of Classical Thermodynamics – G. Van Wylan & R.E. Sonntag – John Wiley Pub.
3. Thermodynamics – J.P.Holman / McGrawHill
4. Engineering Thermodynamics – Jones & Dugan
5. An introduction to Thermodynamics / YVC Rao / New Age
6. Thermodynamics & Heat Engines – Yadav – Central Book Depot, Allahabad.
7. Thermodynamics – Achutan – PHI.
8. Thermodynamics – G.C. Gupta – Pearson Publications.

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## KINEMATICS OF MACHINES

**UNIT – I**

**Mechanisms :** Elements or Links – Classification – Rigid Link, flexible and fluid link – Types of kinematics pairs – sliding, turning, rolling, screw and spherical pairs – lower and higher pairs – closed and open pairs – constrained motion – completely, partially or successfully and incompletely constrained .

**Mechanism and Machines** – Mobility of Mechanisms : Grubler's criterion, classification of machines – kinematics chain – inversions of mechanism – inversions of quadric cycle chain, single and double slider crank chains, Mechanical Advantage.

**UNIT – II**

**Kinematics:** Velocity and acceleration – Motion of link in machine – Determination of Velocity and acceleration – Graphical method – Application of relative velocity method.

**Plane motion of body:** Instantaneous center of rotation- centrodes and axodes – Three centers in line theorem – Graphical determination of instantaneous center, determination of angular velocity of points and links by instantaneous center method.

Kliens construction - Coriolis acceleration - determination of Coriolis component of acceleration

**Analysis of Mechanisms:** Analysis of slider crank chain for displacement- velocity and acceleration of slider – Acceleration diagram for a given mechanism.

**UNIT – III**

**Straight-line motion mechanisms:** Exact and approximate copied and generated types – Peaucellier - Hart - Scott Russel – Grasshopper – Watt -Tchebicheff's and Robert Mechanism - Pantographs

**Steering gears:** Conditions for correct steering – Davis Steering gear, Ackerman's steering gear.

**Hooke's Joint:** Single and double Hooke's joint –velocity ratio – application – problems.

**UNIT – IV**

**Cams:** Definitions of cam and followers – their uses – Types of followers and cams – Terminology – Types of follower motion - Uniform velocity, Simple harmonic motion and uniform acceleration and retardation. Maximum velocity and maximum acceleration during outward and return strokes in the above 3 cases.

**Analysis of motion of followers:** Tangent cam with Roller follower – circular arc cam with straight, concave and convex flanks.

**UNIT – V**

**Higher pair:** Friction wheels and toothed gears – types – law of gearing, condition for constant velocity ratio for transmission of motion – velocity of sliding

Forms of teeth, cycloidal and involutes profiles – phenomena of interferences – Methods of interference. Condition for minimum number of teeth to avoid interference – expressions for arc of contact and path of contact of Pinion & Gear and Pinion & Rack Arrangements– Introduction to Helical – Bevel and worm gearing

**Gear Trains:** Introduction – Types – Simple – compound and reverted gear trains – Epicyclic gear train. Methods of finding train value or velocity ratio of Epicyclic gear trains. Selection of gear box - Differential gear for an automobile

**TEXT BOOKS:**

1. Theory of Machines /S.S.Rattan – Tata McGraw Hill Publishers.
2. Kinematics & Dynamics Of machinery/Norton/TMH

**REFERENCE BOOKS:**

1. Theory of Machines / Thomas Bevan/CBS
2. Theory of Machines / Sadhu Singh / Pearson.
3. Theory of Machines / Shigley / Oxford
4. Mechanism and Machine Theory / JS Rao and RV Duggipati / New Age
5. Theory of Machines by / R.K. Bansal (Lakshmi Publications).

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## MACHINE DRAWING PRACTICE LAB

**Question Paper Pattern:** Question paper has two parts. Part one has five questions out of which answer three (each 10 marks). Part two has one question (assembly with three views) and it is to be answered compulsorily( it carries 50 marks)

**Machine Drawing Conventions:**

Need for drawing conventions – introduction to ISI conventions

1. Conventional representation of materials, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs, ribs.
2. Types of sections – selection of section planes and drawing of sections and auxiliary sectional views. Parts not usually sectioned.
3. Methods of dimensioning, general rules for sizes and placement of dimensions for holes, centers, curved and tapered features.
4. Title boxes, their size, location and details - common abbreviations and their liberal usage
5. Types of Drawings – working drawings for machine parts.

**Drawing of Machine Elements and simple parts**

Selection of Views, additional views for the following machine elements and parts with every drawing proportions.

6. Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, set screws.
7. Keys, cottered joints and knuckle joint.
8. Rivetted joints for plates
9. Shaft coupling, spigot and socket pipe joint.
10. Journal, pivot and collar and foot step bearings.

**Assembly Drawings:**

Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions.

11. Steam engine parts – stuffing boxes, cross heads, Eccentrics.
12. Machine tool parts: Tail stock, Tool Post, Machine Vices.
13. Other machine parts - Screws jacks, Petrol engine connecting rod, Plummer block
14. Simple designs of steam stop valve, spring loaded safety valve, feed check valve and air cock.

**NOTE :** First angle projection to be adopted. The student should be able to provide working drawings of actual parts.

**TEXT BOOK :**

1. Machine Drawing –K.L.Narayana/ Wiley Eastern.

**REFERENCE BOOKS :**

1. Machine Drawing – P.S.Gill.
2. Machine Drawing – Junnarkar N.D./ Pearson Edu.

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## MECHANICS OF SOLIDS AND METALLURGY LAB

**LIST OF EXERCISES:**

1. Introduction about Chain Survey, Compass Survey and Plane Table Survey
2. Leveling – Longitudinal and Cross sectioning and plotting
3. Trigonometric Leveling using Theodolite (Three Exercises)
4. Heights and distance using Principles of Tacheometric surveying (Two Exercises)
5. Curve setting – Using Theodolite (One Exercises)
6. Total station- Determination of area
7. Traversing and Contouring using total station
8. Curve setting Using Total Station
9. Stake-out using total station

**LIST OF EQUIPMENT:**

1. Chains and Compass with accessories like tapes, Ranging rods, cross staff, arrows
2. Plane tables with accessories like Alidade, Plumbing fork, trough compasses
4. Level and leveling staves
5. Theodolites and leveling staves.
6. Total station and related software.

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## FUELS AND LUBRICANTS LAB

1. Determination of Flash and Fire points of Liquid fuels/Lubricants.
2. Carbon residue test: Liquid fuels.
3. Determination of Viscosity: Liquid lubricants.
4. Determination of Calorific value: Solid/Liquid/Gaseous fuels.
5. Greese penetration test.
6. Viscosity determination by Redwood & Saybolt methods.
7. Bomb/ Junkers Gas Calorimeter.

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## FLUID MECHANICS & HYDRAULIC MACHINERY

**UNIT I**

**Fluid Statics**: Dimensions and Units: physical properties of fluids-specific gravity, viscosity, surface tension- vapour pressure and their influence on fluid motion-atmospheric, gauge and vaccum pressure- measurement of pressure- piezometer, U-Tube and Differential Manometers.

**UNIT II**

**Fluid kinematics:** stream line, path line and steak line and stream line, classification of flows steady & un steady, uniform & non uniform, laminar & turbulent, rotational & irrotational flows-equation of continuity for one dimensional flow and three dimensional flow.

**Fluid dynamics:** Surface & body forces Euler's & Bernouli's equations for flow along a stream line, moment equation and its applications on force on pipe bend. Measurement of flow: pitot tube, venture meter and orifice meter, flow nozzle.

**UNIT III**

**Closed conduit flow:** Reynold's experiment-Darcy Weisbach equation-minor losses in pipes-pipes in series and pipes in parallel-total energy line-hydraulic gradient line.

**Boundary layer concepts:** Definition, thicknesses, characteristics along thin plate, laminar and turbulent boundary layers (No derivations) boundary layer in transition, separation of boundary layers submerged objects-drag and lift .

**UNIT IV**

**Basics and hydraulic turbine turbo machinery:** Hydro dynamic force on jets on stationary and moving plate, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency , flow over radial vanes.

Classification of turbines, heads and efficiencies, impulse and reaction turbines, Pelton wheel, Francis turbine, and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design-draft tube theory-functions and efficiency.

**UNIT V**

**Performance of hydraulic turbines and pumps:** Geometric similarity, unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbines, cavitation, surge tank, water hammer.

**Centrifugal pumps:** Classification, working, work done-barometric head-losses and efficiencies specific speed-performance characteristic curves, NPSH.

**Reciprocating pumps:** Working, discharge, slip, indicator diagrams.

**TEXT BOOKS:**

1. Hydraulics, Fluid mechanics and hydraulic machinery by MODI and SETH
2. Fluid mechanics and hydraulic machines by Rajput

**REFERENCES:**

1. Fluid mechanics and fluid power engineering by D.S.Kunar, Kotaria and sons.
2. Fluid mechanics and machinery by D. Rama Durgaiah, New age international.
3. Hydraulic machines by Banga and Sharma, Khanna publishers

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## THERMAL ENGINEERING - I

**UNIT – I**

**I.C. Engines:**

Classification - Working principles of Four & Two stroke engine, SI & CI engines, Valve and Port Timing Diagrams, Air – Standard, air-fuel and actual cycles - Engine systems – Carburetor and Fuel Injection Systems for SI engines, Fuel injection systems for CI engines, Ignition, Cooling and Lubrication system, Fuel properties and Combustion Stoichiometry.

**UNIT – II**

Normal Combustion and abnormal combustion in SI engines – Importance of flame speed and effect of engine variables – Abnormal combustion, pre-ignition and knocking in SI Engines – Fuel requirements and fuel rating, anti knock additives – combustion chamber – requirements, types of SI engines.

Four stages of combustion in CI engines – Delay period and its importance – Effect of engine variables – Diesel Knock– Need for air movement, suction, compression and combustion induced turbulence in Diesel engine – open and divided combustion chambers and fuel injection– Diesel fuel requirements and fuel rating

**UNIT III**

**Testing and Performance:**

Parameters of performance - measurement of cylinder pressure, fuel consumption, air intake, exhaust gas composition, Brake power – Determination of frictional losses and indicated power – Performance test – Heat balance sheet and chart

Classification of compressors – Fans, blowers and compressors – positive displacement and dynamic types – reciprocating and rotary types.

**Reciprocating Compressors:** Principle of operation, work required, Isothermal efficiency volumetric efficiency and effect of clearance volume, staged compression, under cooling, saving of work, minimum work condition for staged compression

**UNIT – IV**

**Rotary Compressor(Positive displacement type):** Roots Blower, vane sealed compressor, Lysholm compressor – mechanical details and principle of working – efficiency considerations.

**Dynamic Compressors:** Centrifugal compressors: Mechanical details and principle of operation – velocity and pressure variation. Energy transfer-impeller blade shape-losses, slip factor, power input factor, pressure coefficient and adiabatic coefficient – velocity diagrams – power.

**Axial Flow Compressors:** Mechanical details and principle of operation – velocity triangles and energy transfer per stage degree of reaction, work done factor - isentropic efficiency-pressure rise calculations – Polytropic efficiency.

**UNIT – V**

**REFRIGERATION :** Mechanical Refrigeration and types – units of refrigeration – Air Refrigeration system, details and principle of operation – applications of air refrigeration, Vapour compression refrigeration systems – calculation of COP – effect of superheating and sub cooling, desired properties of refrigerants and common refrigerants- Vapour absorption system – mechanical details – working principle, Use of p-h charts for calculations

**Air-Conditioning:** Concepts of Psychrometry – Properties of moist air – Usage of Psychrometric Chart – Calculation of moist air properties.

Types of air –conditioning systems – Requirements — schematic layout of a typical plant.

**TEXT BOOKS:**

1. I.C. Engines / V. Ganesan- TMH

2. Thermal Engineering / Rajput / Lakshmi Publications.
3. Thermal Engineering / P.K.Nag

**REFERENCE BOOKS:**

1. IC Engines – Mathur & Sharma – Dhanpath Rai & Sons.
2. Engineering fundamentals of IC Engines – Pulkrabek / Pearson /PHI
3. Thermal Engineering / Rudramoorthy - TMH
4. Thermodynamics & Heat Engines / B. Yadav/ Central Book Depot., Allahabad
5. I.C. Engines / Heywood /McGrawHIll.
6. Thermal Engineering – R.S. Khurmi & J.K.Gupta – S.Chand

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## DYNAMICS OF MACHINES

**UNIT – I**

**Precession:** Gyroscopes – effect of precession – motion on the stability of moving vehicles such as motorcycle – motorcar – aeroplanes and ships.

**Static and Dynamic Force Analysis:** Static force analysis of planar mechanisms – Analytical Method – Dynamic Force Analysis – D'Alembert's principle, Dynamic Analysis of 4-link mechanism, Slider Crank Mechanism.

**UNIT – II**

**Turning Moment Diagram And Flywheels:** Engine Force Analysis – Piston Effort, Crank Effort, etc., Inertia Force in Reciprocating Engine – Graphical Method - Turning moment diagram –fluctuation of energy – flywheels and their design - Inertia of connecting rod-inertia force in reciprocating engines – crank effort and torque diagrams.-.

**UNIT – III**

**Friction:** pivots and collars – uniform pressure, uniform wear – friction circle and friction axis: lubricated surfaces – boundary friction – film lubrication. Clutches – Types – Single plate, multi-plate and cone clutches.

**Brakes And Dynamometers:** Types of brakes: Simple block brake, band and block brake-internal expanding shoe brake-effect of braking of a vehicle. Dynamometers – absorption and transmission types. General description and methods of operation.

**UNIT – IV**

**Governors:** Types of governors - Watt, Porter and Proell governors. Spring loaded governors – Hartnell and Hartung with auxiliary springs. Sensitiveness, isochronisms and hunting – stability – effort and power of the governors.

**Balancing :** Balancing of rotating masses- Primary, Secondary, and higher balancing of reciprocating masses. Analytical and graphical methods. Unbalanced forces and couples.

Examination of "V" and multi cylinder in-line and radial engines for primary and secondary balancing- locomotive balancing – Hammer blow – Swaying couple – variation of tractive effort.

**UNIT – V**

**Vibrations:** Free Vibration of mass attached to vertical spring – Transverse loads – vibrations of beams with concentrated and distributed loads. Dunkerly's method – Raleigh's method. Whirling of shafts – critical speed – torsional vibrations – one, two and three rotor systems.

**TEXT BOOKS:**

1. Theory of Machines, S.S.Rattan.
2. Theory of Machines, R.S.Khurmi

**REFERENCE BOOKS:**

1. Theory of Machines, Shigley, Mc Graw Hill Publishers
2. Theory of Machines, Thomas Bevan, CBS Publishers
3. Theory of Machines, R.K.Bansal (Lakshmi publications)
4. Mechanism and Machine Theory, JS Rao and RV Duggipati, New Age

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## PRODUCTION TECHNOLOGY

**UNIT – I**

**Casting :** Steps involved in making a casting – Advantage of casting and its applications; Patterns - Pattern making, Types, Materials used for patterns, pattern allowances and their construction; Properties of moulding sands.

Methods of Melting - Crucible melting and cupola operation – Defects in castings;

Casting processes – Types – Sand moulding, Centrifugal casting, die- casting, Investment casting, shell moulding; Principles of Gating – Requirements – Types of gates, Design of gating systems – Riser – Function, types of Riser and Riser design.

Solidification of casting – Solidification of pure metal – Nucleation and grain growth, casting design considerations

**UNIT – II**

**Welding:** Classification – Types of welds and welded joints; Gas welding - Types, oxy-fuel gas cutting – standard time and cost calculations. Arc welding, forge welding, submerged arc welding, Resistance welding, Thermit welding.

**UNIT – III**

Inert Gas Welding _ TIG Welding, MIG welding, Friction welding, induction welding, explosive welding, Laser Welding; Soldering and Brazing; Heat affected zone in welding. Welding defects – causes and remedies; destructive and non- destructive testing of welds.

**UNIT – IV**

Hot working, cold working, strain hardening, recovery, recrystallisation and grain growth.

Rolling fundamentals – theory of rolling, types of Rolling mills and products. Forces in rolling and power requirements

Stamping, forming and other cold working processes. Blanking and piercing – Bending and forming – Drawing and its types – wire drawing and Tube drawing – coining – Hot and cold spinning.

Types of presses and press tools. Forces and power requirement in the above operations.

**UNIT – V**

**Extrusion of Metals :** Basic extrusion process and its characteristics. Hot extrusion and cold extrusion - Forward extrusion and backward extrusion – Impact extrusion – Extruding equipment – Tube extrusion and pipe making, Hydrostatic extrusion. Forces in extrusion

**Forging Processes :** Forging operations and principles – Tools – Forging methods – Smith forging, Drop Forging – Roll forging – Forging hammers : Rotary forging – forging defects – cold forging, swaging, Forces in forging operations.

**TEXT BOOKS :**

1. Manufacturing Technology / P.N. Rao/TMH

**REFERENCE BOOKS :**

1. Production Technology / R.K. Jain
2. Metal Casting / T.V Ramana Rao / New Age
3. Principles of Metal Castings / Rosenthal.
4. Welding Process / Parmar /

5. Production Technology /Sarma P C /
6. Manufacturing Engineering and Technology/Kalpakjin S/ Pearson Edu.

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## INSTRUMENTATION AND CONTROL SYSTEMS

**UNIT – I**

Definition – Basic principles of measurement – Measurement systems, generalized configuration and functional description of measuring instruments – examples. Static and Dynamic performance characteristics – sources of errors, Classification and elimination of errors.

**Measurement of Displacement:** Theory and construction of various transducers to measure displacement – Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers, Calibration procedures.

**UNIT – II**

**Measurement of Temperature:** Various Principles of measurement-Classification: Expansion Type: Bimetallic Strip- Liquid in glass Thermometer; Electrical Resistance Type: Thermistor, Thermocouple, RTD; Radiation Pyrometry: Optical Pyrometer; Changes in Chemical Phase: Fusible Indicators and Liquid crystals.

**Measurement of Pressure:** Different principles used- Classification: Manometers, Dead weight pressure gauge. Tester (Piston gauge), Bourdon pressure gauges, Bulk modulus pressure gauges Bellows – Diaphragm gauges. Low pressure measurement – Thermal conductivity gauges, ionization pressure gauges, Mcleod pressure gauge.

**UNIT – III**

**Measurement of Level:** Direct methods – Indirect methods – Capacitive, Radioactive, Ultrasonic, Magnetic, Cryogenic Fuel level indicators – Bubbler level indicators.

**Flow measurement:** Rotameter, magnetic, Ultrasonic, Turbine flow meter, Hot – wire anemometer, Laser Doppler Anemometer (LDA).

**Measurement of Speed :** Mechanical Tachometers, Electrical tachometers, Non- contact type-Stroboscope

**Measurement of Acceleration and Vibration :** Different simple instruments – Principles of Seismic instruments – Vibrometer and accelerometer using this principle- Piezo electric accelerometer.

**UNIT – IV**

**Stress-Strain measurements :** Various types of stress and strain measurements –Selection and installation of metallic strain gauges- electrical strain gauge – gauge factor – method of usage of resistance strain gauge for bending compressive and tensile strains – Temperature compensation techniques, Use of strain gauges for measuring torque, Strain gauge Rosettes.

**Measurement of Humidity:** Moisture content of gases, Sling Psychrometer, Absorption Psychrometer, Dew point meter.

**Measurement of Force, Torque and Power-** Elastic force meters, load cells, Torsion meters, Dynamometers.

**UNIT – V**

**Elements of Control Systems:**

Introduction, Importance – Classification – Open and closed systems- Servomechanisms – Examples with block diagrams – Temperature, speed and position control systems- Transfer functions- First and Second order mechanical systems

**TEXT BOOKS:**

1. Principles of Industrial Instrumentation & Control Systems, Alavala, Cengage Learning
2. Instrumentation, Measurement & Analysis, B.C.Nakra & K.K.Choudhary, TMH
3. Mechanical Measurements & Controls by D.S. Kumar

**REFERENCE BOOKS:**

1. Measurement Systems: Applications & design, E.O.Doebelin, TMH
2. Experimental Methods for Engineers / Holman
3. Mechanical and Industrial Measurements / R.K. Jain/ Khanna Publishers.
4. Mechanical Measurements / Sirohi and Radhakrishna / New Age International

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## FLUID MECHANICS & HYDRAULIC MACHINERY LAB

1. Calibration of Venturimeter & Orifice meter
2. Determination of Coefficient of discharge for a small orifice by a constant head method.
3. Determination of Coefficient of discharge for an external mouth piece by variable head method.
4. Calibration of contracted Rectangular Notch and /or Triangular Notch
5. Determination of Coefficient of loss of head in a sudden contraction and friction factor.
6. Verification of Bernoulli's equation.
7. Performance test on single stage centrifugal pump
8. Performance test on reciprocating pump
9. Impact of jet on vanes
10. Performance and Specific speed test on Pelton wheel (or Turbo Wheel)
11. Performance and specific speed test on Francis Turbine
12. Performance and specific speed test on Kaplan Turbine
13. Performance test on multi stage pump
14. Suitability test on centrifugal pump
15. Drag and Lift Coefficients of an Aerofoil model.

Any ten of the above experiments are to be covered.

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## INSTRUMENTATION & CONTROLSYSTEMS LAB

1. Calibration of Pressure Gauges
2. Calibration of transducer for temperature measurement.
3. Study and calibration of LVDT transducer for displacement measurement.
4. Calibration of strain gauge for temperature measurement.
5. Calibration of thermocouple for temperature measurement.
6. Calibration of capacitive transducer for angular displacement.
7. Study and calibration of photo and magnetic speed pickups for the measurement of speed.
8. Calibration of resistance temperature detector for temperature measurement.
9. Study and calibration of a rotometer for flow measurement.
10. Study and use of a Seismic pickup for the measurement of vibration amplitude of an engine bed at various loads.
11. Study and calibration of McLeod gauge for low pressure.

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## PRODUCTION TECHNOLOGY LAB

**Metals Casting Lab :**

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| 1. | Moulding | - | 2 Exercises |
| 2. | Melting & Casting | - | Demonstration |
| 3. | Pattern Marking | - | 1 Exercise |

**Welding Lab:**

1) Arc Welding:

a) Effect of polarity on welds strength & Heat affected zone
b) Effect of current on weld strength and Heat affected zone

2) Spot Welding – Effect of current on weld strength.

3) Gas welding and brazing exercises.

**Mechanical Press Working:**

1) Blanking & Piercing operation & Study of simple Compound and progressive press tools.
2) Hydraulic Press: Deep Drawing and Extrusion Operations.
3) Bending and other operations.

**Processing of Plastics:**

1) Injection Moulding
2) Blow Moulding

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## HUMAN VALUES AND PROFESSIONAL ETHICS

**Unit 1 Human Values:** Morals, values, ethics – integrity – work ethics –service learning – civic virtue – respect for others- living peacefully - Caring –sharing –honesty – courage – valuing time – cooperation – commitment –empathy – self-confidence –spirituality – character- Mini-Cases

**Unit II Professional Ethics:** Profession- and professionalism - Two models of professionalism –Professional etiquette -Three types of Ethics or morality Responsibility in Engineering – Engineering standards –Engineering Ethics – Positive and Negative Faces. Professional Codes and Code of conduct (as given by ASME, ASCE, IEEE, IETE, Institute of Engineers as Guidelines for ethical conduct). Mini-cases.

**Unit III Professional Responsibilities:** Ethical standards Vs Professional Conduct – Zero Tolerance for Culpable Mistakes – Hazards and Risks- Risk benefit analysis– congeniality, collegiality and loyalty. Respect for authority – conflicts of interest – occupational crime — Mini-Cases.

**Unit IV Professional Rights:** professional rights and employee rights communicating risk and public policy – Whistle blowing - collective bargaining. Professionals /engineers as managers, advisors, experts, witnesses and consultants – moral leadership- Regulatory compliances, Monitoring and control- Mini-Cases

**Unit V Ethics in global context:** Global issues in MNCs- Problems of bribery, extortion, and grease payments – Problem of nepotism, excessive gifts – paternalism – different business practices – negotiating taxes. Mini-Cases.

### Mini-projects

**Project 1:** The student of this course should invariably attend (or watch on internet/any TV channel/youtube/social media) two speeches of 30 minutes duration each dealing with spiritual discourse and submit a report on the contents of the lecture proceedings.

**Project 2:** Visit any organization (including shops/ hotels or shopping malls in your region) of your choice and observe how the professionals perform the given job with a focus on professional ethics and human values.

### References

1. Aryasri, *Human Values and Professional Ethics*, Maruthi Publications.
2. S B George, *Human Values and Professional Ethics,* Vikas Publishing.
3. KR Govindan & Saenthil Kumar:Professional *Ethics and Human Values*, Anuradha Publications.
4. S K Chakraborthy & D.Chakraborthy: *Human Values and Ethics*, Himalaya.
5. M. Govindarajan, S. Natarajan, & V.S. Senthilkumar: *Engineering Ethics(Includes Human Values),* HI Learning Pvt. Ltd., New Delhi – 110001

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## DESIGN OF MACHINE MEMBERS - I

**NOTE :** Design Data books are not permitted in the Examinations. The design must not only satisfy strength criteria but also rigidity criteria.

**UNIT – I**

**INTRODUCTION:** General considerations in the design of Engineering Materials and their properties – selection –Manufacturing consideration in design. Tolerances and fits –BIS codes of steels.

**STRESSES IN MACHINE MEMBERS:** Simple stresses – Combined stresses – Torsional and Bending stresses – Impact stresses – Stress strain relation – Various theories of failure – Factor of safety – Design for strength and rigidity – preferred numbers. The concept of stiffness in tension, bending, torsion and combined situations.

**UNIT – II**

**STRENGTH OF MACHINE ELEMENTS:** Stress concentration – Theoretical stress Concentration factor – Fatigue stress concentration factor- Notch Sensitivity – Design for fluctuating stresses – Endurance limit – Estimation of Endurance strength – Goodman's line – Soderberg's line – Modified goodman's line.

**UNIT – III**

Riveted and welded joints – Design of joints with initial stresses – eccentric loading-Bolted joints – Design of bolts with pre-stresses – Design of joints under eccentric loading – locking devices – bolts of uniform strength.

**UNIT – IV**

**KEYS, COTTERS AND KNUCKLE JOINTS:** Design of Keys-stresses in keys-cottered joints-spigot and socket, sleeve and cotter, jib and cotter joints-Knuckle joints.

**UNIT – V**

**SHAFTS:** Design of solid and hollow shafts for strength and rigidity – Design of shafts for combined bending and axial loads – Shaft sizes – BIS code. Use of internal and external circlips, Gaskets and seals (stationary & rotary)

**SHAFT COUPLINGS :** Rigid couplings – Muff, Split muff and Flange couplings. Flexible couplings – Flange coupling (Modified).

**TEXT BOOKS:**

1. Machine design / P. Kannaiah/ Scitech Publishers
2. Machine design/pandya & shah
3. Machine Design/ V. Bandari/ TMH Publishers

**REFERENCE BOOKS:**

1. Machine Design , Soundararajan/ Murthy and Shanmugam
2. Design of Machine Elements/V.M. Faires
3. Machine design/ Schaum Series.
4. Mechanical Engineering Design/JE Shigley

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## THERMAL ENGINEERING - II

**UNIT – I**

**Steam Power Plant:** Rankine cycle - Schematic layout, Thermodynamic Analysis, Concept of Mean Temperature of Heat addition, Methods to improve cycle performance – Regeneration & reheating.

**Boilers** – Classification – Working principles with sketches including H.P.Boilers – Mountings and Accessories – Working principles- Boiler horse power, Equivalent Evaporation, Efficiency and Heat balance – Draught- Classification – Height of chimney for given draught and discharge- Condition for maximum discharge- Efficiency of chimney.

**UNIT – II**

**Steam Nozzles :** Stagnation Properties- Function of nozzle – Applications and Types- Flow through nozzles- Thermodynamic analysis – Assumptions -Velocity of nozzle at exit-Ideal and actual expansion in nozzle- Velocity coefficient- Condition for maximum discharge- Critical pressure ratio- Criteria to decide nozzle shape- Super saturated flow, its effects, Degree of super saturation and Degree of under cooling - Wilson line.

**UNIT – III**

**Steam Turbines:** Classification – Impulse turbine; Mechanical details – Velocity diagram – Effect of friction – Power developed, Axial thrust, Blade or diagram efficiency – Condition for maximum efficiency. De-Laval Turbine - its features- Methods to reduce rotor speed- Velocity compounding and Pressure compounding- Velocity and Pressure variation along the flow – Combined velocity diagram for a velocity compounded impulse turbine.

**Reaction Turbine:** Mechanical details – Principle of operation, Thermodynamic analysis of a stage, Degree of reaction –Velocity diagram – Parson's reaction turbine – Condition for maximum efficiency.

**UNIT IV**

**Steam Condensers**: Requirements of steam condensing plant – Classification of condensers – Working principle of different types – Vacuum efficiency and Condenser efficiency – Air leakage, sources and its affects, Air pump- Cooling water requirement.

**Gas Turbines:** Simple gas turbine plant – Ideal cycle, essential components – Parameters of performance – Actual cycle – Regeneration, Inter cooling and Reheating –Closed and Semi-closed cycles – Merits and Demerits- Combustion chambers and turbines of Gas Turbine Plant- Brief Concepts.

**UNIT – V**

**Jet Propulsion :** Principle of Operation –Classification of jet propulsive engines – Working Principles with schematic diagrams and representation on T-S diagram - Thrust, Thrust Power and Propulsion Efficiency – Turbo jet engines – Needs and Demands met by Turbo jet – Schematic Diagram, Thermodynamic Cycle, Performance Evaluation Thrust Augmentation – Methods.

**Rockets:** Application – Working Principle – Classification – Propellant Type – Thrust, Propulsive Efficiency – Specific Impulse – Solid and Liquid propellant Rocket Engines.

**TEXT BOOKS:**

1. Thermal Engineering / Rajput / Lakshmi Publications
2. Gas Turbines – V.Ganesan /TMH

3. Thermodynamics and Heat Engines / R. Yadav / Central Book Depot
4. Thermal Engineering / Ajoy Kumar/ Narosa

**REFERENCE BOOKS:**

1. Gas Turbines and Propulsive Systems – P.Khajuria & S.P.Dubey - /Dhanpatrai Pub
2. Thermal Engineering – Ballaney / Khanna Pub.
3. Gas Turbines / Cohen, Rogers and Saravana Muttoo / Addison Wesley – Longman
4. Thermal Engineering – R.S. Khurmi & J.S.Gupta / S.Chand Pub.

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## METROLOGY

**UNIT – I**

**Systems of limits and fits :** Introduction, normal size, tolerance limits, deviations, allowance, fits and their types – unilateral and bilateral tolerance system, hole and shaft basis systems – interchangeability and selective assembly. Indian Standard system – International Standard system.

**UNIT – II**

**Linear Measurement :** Length standard: line and end standard, slip gauges – calibration & manufacture of the slip gauges, Dial indicator, micrometers.

**Measurement Of Angles and Tapers:** Different methods – Bevel protractor – angle slip gauges – spirit levels – Sine bar – Use of Rollers and Balls to determine the tapers.

**UNIT – III**

**Limit Gauges :** Taylor's principle; Types of gauges - plug, ring, snap, taper, profile and position gauges - Design of GO and NO GO gauges

**Optical Measuring Instruments:** Tool maker's microscope and its uses – collimators, optical projector – optical flats and their uses, interferometer.

**Flat Surface Measurement :** Measurement of flat surfaces – instruments used: straight edges, surface plates, optical flat and auto collimator.

**UNIT – IV**

**Surface Roughness Measurement :** Differences between surface roughness and surface waviness – Numerical assessment of surface finish: CLA, R.M.S Values, $R_z$ values- Methods of measurement of surface finish: profilograph, Talysurf- ISI symbols for indication of surface finish.

**Measurement Through Comparators :** Comparators: Mechanical, Electrical and Electronic Comparators, Pneumatic comparators and their uses in mass production.

**Screw Thread Measurement :** Element of measurement – errors in screw threads – measurement of effective diameter, angle of thread and thread pitch, profile thread gauges.

**UNIT -V**

**Gear Measurement:** Gear measuring instruments, Gear tooth profile measurement, Measurement of diameter, pitch pressure angle and tooth thickness.

**Machine Tool Alignment Tests:** Requirements of Machine Tool Alignment Tests, Alignment tests on lathe, milling, drilling machine tools. Preparation of acceptance charts.

**Coordinate Measuring Machines**: Types of CMM, Role of CMM, and Applications of CMM.

**TEXT BOOKS :**

1. Engineering Metrology / I C Gupta./ Danpath Rai
2. Engineering Metrology / R.K. Jain / Khanna Publishers

**REFERENCE BOOKS :**

1. BIS Standards on Limits & Fits, Surface Finish, Machine Tool Alignment etc.
2. Fundamentals of Dimensional Metrology 4e / Connie Dotson / Thomson

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## OPEN ELECTIVE-I
## GIS & REMOTE SENSING

**UNIT – I**

Introduction to Photogrammetry: Principle and types of aerial photographs, stereoscopy, Map Vs Mosaic, ground control, Parallax measurements for height, determinations.

Remote Sensing – I: Basic concepts and foundation of remote sensing – elements involved in remote sensing, electromagnetic spectrum, remote sensing terminology and units.

**UNIT - II**

Remote Sensing – II: Energy resources, energy interactions with earth surface features and atmosphere, resolution, sensors and satellite visual interpretation techniques, basic elements, converging evidence, interpretation for terrain evaluation, spectral properties of water bodies, introduction to digital data analysis.

**UNIT – III**

Geographic Information System: Introduction, GIS definition and terminology, GIS categories, components of GIS, fundamental operations of GIS, A theoretical framework for GIS.

Types of data representation: Data collection and input overview, data input and output. Keyboard entry and coordinate geometry procedure, manual digitizing and scanning, Raster GIS, Vector GIS – File management, Spatial data – Layer based GIS, Feature based GIS mapping.

**UNIT – IV**

GIS Spatial Analysis: Computational Analysis Methods (CAM), Visual Analysis Methods (VAM), Data storage-vector data storage, attribute data storage, overview of the data manipulation and analysis. Integrated analysis of the spatial and attribute data.

**UNIT – V**

Water Resources Applications-I: Land use/Land cover in water resources, Surface water mapping and inventory, Rainfall – Runoff relations and runoff potential indices of watersheds, Flood and Drought impact assessment and monitoring, Watershed management for sustainable development and Watershed characteristics.

Water Resources Applications – II: Reservoir sedimentation, Fluvial Geomorphology, water resources management and monitoring, Ground Water Targeting, Identification of sites for artificial Recharge structures, Drainage Morphometry, Inland water quality survey and management, water depth estimation and bathymetry.

**TEXT BOOKS:**

1. Remote Sensing and its applications by LRA Narayana University Press 1999.
2. Principals of Geo physical Information Systems – Peter A Burragh and Rachael A. Mc Donnell, Oxford Publishers 2004.

**REFERENCES:**

1. Concepts & Techniques of GIS by C.P.Lo Albert, K.W. Yonng, Prentice Hall (India) Publications.
2. Remote Sensing and Geographical Information systems by M.Anji Reddy JNTU Hyderabad 2001, B.S.Publications.
3. GIS by Kang – tsung chang, TMH Publications & Co.,
4. Basics of Remote sensing & GIS by S.Kumar, Laxmi Publications.
5. Fundamental of GIS by Mechanical designs John Wiley & Sons.

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## OPEN ELECTIVE-I
## NON CONVENTIONAL POWER GENERATION

**UNIT - I**

Fundamentals of Solar Energy-Solar spectrum- Solar Radiation on Earth's surface-Solar radiation geometry-Solar radiation measurements- Solar radiation data- Solar radiation on horizontal and tilted surfaces. Solar Thermal conversion- Flat plate collectors- concentrated collectors- construction and thermal analysis- Solar applications- Solar ponds- Heliostat systems-water heater-air heater-solar still.

**UNIT - II**

Solar-Electric Power generation- Photovoltaic cells- Equivalent circuit- V-I Characteristics-Photovoltaic modules – constructional details- design considerations- Tracking- Maximum power point tracking – algorithms - PV solar system design with energy back up- Solar Thermo electric conversion.

**UNIT - III**

Wind Energy- Fundamentals of wind energy-power available in wind- Betz Limit-Aerodynamics of wind turbine- Wind turbines- Horizontal and vertical axis turbines –their configurations- Wind Energy conversion systems.

**UNIT - IV**

Energy from Bio Mass- Various fuels- Sources-Conversion technologies-Wet Processes – Dry Processes- Bio Gas generation – Aerobic and anaerobic digestion-Factors affecting generation of bio gas –Classification of bio gas plants-Different Indian digesters- Digester design considerations- Gasification process-Gasifiers – Applications. Geothermal Energy-sources-Hydrothermal convective- Geo-pressure resources- Petro-thermal systems(HDR)-Magma Resources-Prime Movers.

**UNIT - V**

OTEC Systems- Principle of operation-Open and closed cycles, Energy from Tides- Principle of Tidal Power- Components of tidal Power plants-Operation Methods-Estimation of Energy in Single and double basin systems- Energy and Power from Waves-Wave energy conversion devices- Fuel Cells-Design and Principle of operation-Types of Fuel Cells-Advantages and disadvantages-Types of Electrodes- Applications-Basics of Batteries –Constructional details of Lead acid batteries- Ni-Cd Batteries.

**Text Books**

1. John Twidell & Wier, Renewable Energy Resouces, CRC Press, 2009.
2. G.D.Rai – Non Conventional Energy sources, Khanna publishers.

**References**

1. D.P .Kothari, Singal,Rakesh, Ranjan, Renewable Energy sources and Emerging Technologies, PHI, 2009.
2. F.C.Treble, Generating Electricity from Sun.
3. C.S.Solanki , Solar Photo volatics- Fundamentls- Principles and Applications, PHI 2009
4. S.P.Sukhatme , Solar Energy Principles and Application - TMH

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## OPEN ELECTIVE-I
## OPERATIONS RESEARCH

**UNIT – I**

Development – Definition– Characteristics and Phases – Types of models – Operations Research models – applications.

**ALLOCATION:** Linear Programming Problem - Formulation – Graphical solution – Simplex method – Artificial variables techniques: Two–phase method, Big-M method; Duality Principle.

**UNIT – II**

**TRANSPORTATION PROBLEM** – Formulation – Optimal solution, unbalanced transportation problem – Degeneracy.

**Assignment problem** – Formulation – Optimal solution - Variants of Assignment Problem; Traveling Salesman problem.

**UNIT – III**

**SEQUENCING** – Introduction – Flow –Shop sequencing – n jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through 'm' machines

**REPLACEMENT:** Introduction – Replacement of items that deteriorate with time – when money value is not counted and counted – Replacement of items that fail completely- Group Replacement.

**UNIT – IV**

**THEORY OF GAMES:** Introduction –Terminology– Solution of games with saddle points and without saddle points- 2 x 2 games –m x 2 & 2 x n games - graphical method – m x n games - dominance principle.

**INVENTORY:** Introduction – Single item, Deterministic models – Types - Purchase inventory models with one price break and multiple price breaks –Stochastic models – demand discrete variable or continuous variable – Single Period model with no setup cost.

**UNIT – V**

**WAITING LINES:** Introduction – Terminology-Single Channel – Poisson arrivals and Exponential Service times – with infinite population and finite population models– Multichannel – Poisson arrivals and exponential service times with infinite population.

**DYNAMIC PROGRAMMING:**

Introduction – Terminology- Bellman's Principle of Optimality – Applications of dynamic programming- shortest path problem – linear programming problem.

**TEXT BOOK :**

1. Operation Research /J.K.Sharma/MacMilan.
2. Introduction to O.R /Taha/PHI

**REFERENCE BOOKS :**

1. Operations Research: Methods and Problems / Maurice Saseini, Arhur Yaspan and Lawrence Friedman
2. Operations Research /A.M.Natarajan, P.Balasubramaniam, A. Tamilarasi/Pearson Education.
3. Operations Research / Wagner/ PHI Publications.
4. Introduction to O.R/Hillier & Libermann (TMH).

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## OPEN ELECTIVE-I
## ELECTRONIC MEASUREMENTS AND INSTRUMENTATION

**UNIT I:**

**Block Schematics of Measuring Systems:** Performance Characteristics, Static Characteristics, Accuracy, Precision, Resolution, Types of Errors, Gaussian Error, Root Sum Squares formula, Dynamic Characteristics, Repeatability, Reproducibility, Fidelity, Lag ;Measuring Instruments: DC Voltmeters, D' Arsonval Movement, DC Current Meters, AC Voltmeters and Current Meters, Ohmmeters, Multimeters, Meter Protection, Extension of Range, True RMS Responding Voltmeters, Specifications of Instruments.

.**UNIT II:**

**Signal Analyzers**: AF, HF Wave Analyzers, Harmonic Distortion, Heterodyne wave Analyzers, Spectrum Analyzers, Power Analyzers, Capacitance-Voltage Meters, Oscillators. Signal Generators: AF, RF Signal Generators, Sweep Frequency Generators, Pulse and Square wave Generators, Function Generators, Arbitrary Waveform Generator, Video Signal Generators, and Specifications

**UNIT III:**

**Oscilloscopes:** CRT, Block Schematic of CRO, Time Base Circuits, Lissajous Figures, CRO Probes, High Frequency CRO Considerations, Delay lines, Applications: Measurement of Time, Period and Frequency Specifications.

**Special Purpose Oscilloscopes**: Dual Trace, Dual Beam CROs, Sampling Oscilloscopes, Storage Oscilloscopes, Digital Storage CROs.

**UNIT IV:**

**Transducers:** Classification, Strain Gauges, Bounded, unbounded; Force and Displacement Transducers, Resistance Thermometers, Hotwire Anemometers, LVDT, Thermocouples, Synchros, Special Resistance Thermometers, Digital Temperature sensing system, Piezoelectric Transducers, Variable Capacitance Transducers, Magneto Strictive Transducers.

**UNIT V**:

**Bridges:** Wheat Stone Bridge, Kelvin Bridge, and Maxwell Bridge.

**Measurement of Physical Parameters**: Flow Measurement, Displacement Meters, Liquid level Measurement, Measurement of Humidity and Moisture, Velocity, Force, Pressure – High Pressure, Vacuum level, Temperature -Measurements, Data Acquisition Systems.

**TEXT BOOKS:**

1. Electronic Measurements and Instrumentation – K. Lal Kishore, Pearson Education 2010.
2. Electronic Instrumentation: H.S.Kalsi – TMH, 2nd Edition 2004.

**REFERENCES:**

1. Electronic Instrumentation and Measurements – David A. Bell, Oxford Univ. Press, 1997.
2. Modern Electronic Instrumentation and Measurement Techniques: A.D. Helbincs, W.D. Cooper: PHI 5th Edition 2003.

3. Electronic Measurements and Instrumentation: B.M. Oliver, J.M. Cage TMH Reprint 2009.
4. Industrial Instrumentation: T.R. Padmanabham Springer 2009.

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## OPEN ELECTIVE-I
## OBJECT ORIENTED PROGRAMMING THROUGH JAVA

**UNIT I :**

**Object oriented thinking and Java Basics**- Need for oop paradigm, summary of oop concepts, coping with complexity, abstraction mechanisms. A way of viewing world – Agents, responsibility, messages, methods, History of Java, Java buzzwords, data types, variables, scope and life time of variables, arrays, operators, expressions, control statements, type conversion and casting, simple java program, concepts of classes, objects, constructors, methods, access control, this keyword, garbage collection, overloading methods and constructors, method binding, inheritance, overriding and exceptions, parameter passing, recursion, nested and inner classes, exploring string class.

**UNIT II :**

**Inheritance, Packages and Interfaces** – Hierarchical abstractions, Base class object, subclass, subtype, substitutability, forms of inheritance- specialization, specification, construction, extension, limitation, combination, benefits of inheritance, costs of inheritance. Member access rules, super uses, using final with inheritance, polymorphism- method overriding, abstract classes, the Object class.

Defining, Creating and Accessing a Package, Understanding CLASSPATH, importing packages, differences between classes and interfaces, defining an interface, implementing interface, applying interfaces, variables in interface and extending interfaces.

Exploring java.io.

**UNIT III**

**Exception handling and Multithreading-**- Concepts of exception handling, benefits of exception handling, Termination or resumptive models, exception hierarchy, usage of try, catch, throw, throws and finally, built in exceptions, creating own exception sub classes.

String handling,Exploring java.util.Differences between multi threading and multitasking, thread life cycle,creating threads, thread priorities, synchronizing threads, interthread communication, thread groups,daemon threads.

Enumerations, autoboxing, annotations, generics.

**UNIT IV :**

**Event Handling** : Events, Event sources, Event classes, Event Listeners, Delegation event model, handling mouse and keyboard events, Adapter classes.

The AWT class hierarchy, user interface components- labels, button, canvas, scrollbars, text components, check box, check box groups, choices, lists panels – scrollpane, dialogs, menubar, graphics, layout manager – layout manager types – border, grid, flow, card and grid bag.

**UNIT V :**

**Applets** – Concepts of Applets, differences between applets and applications, life cycle of an applet, types of applets, creating applets, passing parameters to applets.

**Swing** – Introduction, limitations of AWT, MVC architecture, components, containers, exploring swing- JApplet, JFrame and JComponent, Icons and Labels, text fields, buttons – The JButton class, Check boxes, Radio buttons, Combo boxes, Tabbed Panes, Scroll Panes, Trees, and Tables.

**TEXT BOOKS :**

1. Java the complete reference, 7th editon, Herbert schildt, TMH.
2. Understanding OOP with Java, updated edition, T. Budd, pearson eduction.

**REFERENCES :**

1. An Introduction to programming and OO design using Java, J.Nino and F.A. Hosch, John wiley & sons.
2. An Introduction to OOP, third edition, T. Budd, pearson education.
3. Introduction to Java programming, Y. Daniel Liang, pearson education.
4. An introduction to Java programming and object oriented application development, R.A. Johnson- Thomson.
5. Core Java 2, Vol 1, Fundamentals, Cay.S.Horstmann and Gary Cornell, eighth Edition, Pearson Education.
6. Core Java 2, Vol 2, Advanced Features, Cay.S.Horstmann and Gary Cornell, eighth Edition, Pearson Education
7. Object Oriented Programming with Java, R.Buyya,S.T.Selvi,X.Chu,TMH.
8. Java and Object Orientation, an introduction, John Hunt, second edition, Springer.
9. Maurach's Beginning Java2 JDK 5 , SPD.
10. Programming and Problem Solving with Java, JM Slack, B S Publications.

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## OPEN ELECTIVE-I
## DATA STRUCTURES & ANALYSIS OF ALGORITHMS

**Objectives:**

- To understand the basic concepts such as Abstract Data Types. Linear and Non Linear Data Structure.
- To understand the notations used to analyze the performance of algorithms
- To understand the behavior of data structures such as Trees, Graphs and their representation
- To choose the appropriate data structure for a specified application
- To analyze performance of algorithms
- To choose the appropriate data structure and algorithm design method for a specified application
- To understand how the choice of data structures and algorithms design methods impacts the performance of programs
- To solve problems using algorithms design methods such as the greedy method, divide and conquer, dynamic programming, Prerequisites Data structures, Mathematical foundations of computer science

**Unit I:**

**C++ Class Overview**- Class Definition, Objects, Class Members, Access Control, Class Scope, Constructors and destructors, parameter passing methods, Inline functions, static class members, this pointer, friend functions, dynamic memory allocation and deal location (new and delete), exception handling.

Function Over Loading, Operator Overloading, Generic Programming- Function and class templates, Inheritance basics, base and derived classes, inheritance types, base class access control, runtime polymorphism using virtual functions, abstract classes, streams I/O.

**Unit II:**

**Algorithms**, performance analysis- time complexity and space complexity. Review of basic data structures- The list ADT, Stack ADT, Queue ADT, Implementation using template classes in C++.

Dictionaries, linear list representation, skip list representation, operations insertion, deletion and searching.

**Unit III:**

**Trees:** Definition, ADT, Trees Implementation Methods. Trees Traversal Methods

**Graphs:** Definition, ADT, Graphs Implementation Methods. Graphs Traversal Methods.

**Priority Queues** – Definition, ADT, Realizing a Priority Queue using Heaps, Definition, insertion, Deletion.

**Unit IV:**

**Algorithms:** Pseudo code for expressing algorithms, Performance Analysis-Space complexity, Time complexity, Asymptotic Notation- Big oh notation, Omega notation, Theta notation and Little oh notation, Probabilistic analysis, Amortized analysis.

**Divide and conquer:** General method, applications-Binary search, Quick sort, Merge sort, Stassen's matrix multiplication.

**Unit V:**

**Dynamic Programming:** General method, applications-Matrix chain multiplication, Optimal binary search trees, 0/1 knapsack problem, All pairs shortest path problem, Travelling sales person problem, Reliability design.

**TEXT BOOKS:**

1. Data structures, Algorithms and Applications in C++, S.Sahni, University Press (India) Pvt. Ltd, 2nd edition, Universities Press Orient Longman Pvt. Ltd.
2. Data structures and Algorithms in C++, Michael T.Goodrich, R.Tamassia and .Mount, Wiley student edition, John Wiley and Sons.

**REFERENCES :**

1. Data structures and Algorithm Analysis in C++, Mark Allen Weiss, Pearson Education. Ltd., Second Edition.
2. Data structures and algorithms in C++, 3rd Edition, Adam Drozdek, Thomson
3. Data structures using C and C++, Langsam, Augenstein and Tanenbaum, PHI.
4. Problem solving with C++, The OOP, Fourth edition, W.Savitch, Pearson education

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## OPEN ELECTIVE-I
## OPERATING SYSTEMS

**Objectives**:

- Provide an introduction to operating system concepts (i.e., processes, threads, scheduling, synchronization, deadlocks, memory management, file and I/O subsystems and protection) as fundamental principles by reference to real systems
- To give exposure to the professional responsibilities that are part of operating system design and development.
- To provide the student with the ability to write system oriented programs on Unix/Linux.

**UNIT I:**

**Operating System Introduction**, Structures - Simple Batch, Multi programmed, Time-shared, Personal Computer, Parallel, Distributed Systems,Real-Time Systems , System components, Operating-System services, System Calls, Virtual Machines, System Design and Implementation.

**UNIX/LINUX Utilities -** Introduction to Unix file system, vi editor, file handling utilities, security by file permissions, process utilities, disk utilities, networking commands, text processing utilities and backup utilities,

**Working with Bash shell:** what is a shell, shell responsibilities, pipes and input Redirection, output redirection, here documents, the shell as a programming language, shell meta characters, shell variables, shell commands, the environment, control structures, shell script examples.

**UNIT II:**

**Process and CPU Scheduling** - Process concepts and scheduling, Operation on processes, Cooperating Processes, Threads, and Interposes Communication Scheduling Criteria, Scheduling Algorithm, Multiple -Processor Scheduling, Real-Time Scheduling.

**System call interface for process management**-fork, exit, wait, waitpid, exec,

**Deadlocks** - System Model, Dead locks Characterization, Methods for Handling Dead locks Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, and Recovery from Deadlock.

**UNIT – III:**

**Process Management and Synchronization** - The Critical Section Problem, Synchronization Hardware, Semaphores, and Classical Problems of Synchronization, Critical Regions, Monitors.

**Interprocess Communication Mechnisms:** IPC between processes on a single computer system, IPC between processes on different systems, using pipes, fifos, message queues, shared memory, semaphores.

**UNIT IV**

**Memory Management and Virtual Memory** - Logical versus Physical Address Space, Swapping, Contiguous Allocation, Paging, Segmentation, Segmentation with Paging. Demand Paging , Performance of Demanding Paging , Page Replacement ,Page Replacement Algorithm, Allocation of Frames, Thrashing.

**UNIT V:**

**File System Interface and Implementation** -Access methods, Directory Structure, Protection, File System Structure, Allocation methods, Free-space Management, Directory Management, Directory Implementation, Efficiency and Performance.

**Unix/LINUX Files:** File structure, directories, files and devices, System calls, library functions, low level file access, usage of open, creat, read, write, close, lseek, stat, ioctl.

**TEXT BOOKS:**

1. Operating System Principles- Abraham Silberchatz, Peter B. Galvin, Greg Gagne 7th Edition, John Wiley
2. Operating Systems – Internals and Design Principles Stallings, Fifth Edition–2005, Pearson Education/PHI
3. Unix the ultimate guide, Sumitabha Das, TMH.
4. Advanced programming in the Unix environment, W.R.Stevens, Pearson education.

**REFERENCE BOOKS:**

1. Operating System A Design Approach-Crowley,TMH.
2. Modern Operating Systems, Andrew S Tanenbaum 2nd edition Pearson/PHI
3. Operating Systems, Dhamdhere, TMH
4. Unix system programming using C++, T.Chan, PHI.
5. Unix programming environment, Kernighan and Pike, PHI. / Pearson Education
6. Unix Internals The New Frontiers, U.Vahalia, Pearson Education.
7. Unix for programmers and users, 3rd edition, Graham Glass, King Ables, Pearson Education

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## OPEN ELECTIVE-I
## MATERIALS SCIENCE

**UNIT – 1**

Engineering materials. Mechanical properties. Structure-property relation. Grains and grain boundaries. Slip. Determination of grain size. Microstructure and strength. Crystal structure and ductility.

**UNIT – 2**

Constitution of alloys. Necessity of alloying. Types of solid solutions. Hume-Rothery rules. Intermediate alloy phases. Intermetallic compounds. Electron compounds.
Phase diagrams. Construction and interpretation. Isomorphous and eutectic systems. Cu-Ni and Pb-Sn phase diagrams. Lever rule. Phase rule.

**UNIT - 3**

The iron-carbon phase diagram. Polymorphism. Phases. Structure and properties of hypoeutectoid and hypereutectoid steels and cast irons ( white cast iron, malleable cast iron, gray cast iron, nodular cast iron).

**UNIT-4:**

Heat treatment of steels. TTT diagrams. Annealing, normalizing, hardening, tempering. Effect of alloying elements on the Fe-C diagram and TTT diagram. Hardenability.
Heat treatment of nonferrous alloys. Precipitation hardening. Al-Cu phase diagram. Composite materials I. Particle-reinforced composites (Cu-Al2O3, WC-Co). Manufacturing techniques.

**UNIT-5:**

Ceramics. Crystalline ceramics. Classification: Clay products, Refractories, Abrasives. Applications. Glasses. Strain point, annealing point, softening point, working point, melting point.
Composite materials II. Fiber-reinforced composites. Role of fibre phase and matrix phase. Polymer-matrix, Metal-matrix, and tranformation-toughened ceramic matrix composites. Processing and Applications.

**TEXT BOOKS**

1. Materials Science and Engineering. An introduction, WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007
2. Metallurgy for Engineers – Clark and Varney
3. Elements of Materials Science – V Raghavan

**REFERENCE BOOKS**

1. Foundations of Materials Science and Engineering – WF Smith
2. C. Suryanarayana, Experimental Techniques in Mechanics and Materials, John Wiley, NJ, USA, 2006
3. Introduction to Physical Metallurgy , SH Avner, Tata McGraw-Hill edition, 1997

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## OPEN ELECTIVE-I
## NANOTECHNOLOGY

**Unit 1: Background of Nanotechnology**
Scientific Revolutions, Nanotechnology and Nanomachines,The Periodic Table, Atomic Structure, Molecules and Phases, Energy, Molecular and Atomic size, Surfaces and Dimensional Space, Top down and Bottom up approach.

**Unit 2: Molecular Nanotechnology**
Atoms by inference, Electron Microscopes, Scanning electron microscope, Modern transmission electron microscope, Scanning probe microscope-atomic force microscope, Scanning tunneling microscope, Self Assembly.

**Unit 3: Nanopowders and Nanomaterials**
What are nanomaterials? Preparation, Plasma arcing, chemical vapor deposition, Sol-gels, Electrodeposition, Ball milling, using natural nanoparticles, Applications of nanomaterials.

**Unit 4: Nanoelectronics**
Approaches to nanoelectronics, Fabrication of integrated circuits, MEMS, NEMS, Nano circuits, Quantum wire, Quantum well, DNA-directed assembly and application in electronics.

**Unit 5: Applications**
MEMS, NEMS, Coatings, Optoelectronic Devices, Environmental Applications, Nanomedicine.

**Text Books**
1. Introduction to Nanoscience and Nanotechnology Gabor L. Hornyak, **NanoThread, Inc., Golden, Colorado, USA**; H.F. Tibbals, **University of Texas Southwestern Medical Center, Dallas, USA**; Joydeep Dutta, **Asian Institute of Technology, Pathumthani, Thailand**; John J. Moore, **Colorado School of Mines, Golden, USA**
2. Introduction to Nanotechnology by Charles P. Poole Jr and Frank J.Owens Wiley India Pvt Ltd.
3. Introduction to Nanoscience and Nanotechnology, Chatopadhyaya.K.K, and Banerjee A.N,
4. Introduction to nano tech by phani kumar
5. Introduction to Nano Technology by Charles P. Poole Jr and Frank J. Owens. Wiley India Pvt Ltd.
6. Introduction to Nanoscience and Nanotechnology, Chatopadhyaya.K.K, and Banerjee A.N,
   NANOTECHNOLOGY Basic Science and EmergingTechnologies by Michael Wilson, Kamali Kannangara Geoff Smith, Michelle Simmons, Burkhard Raguse**-** CHAPMAN & HALL/CRC PRESS 2002.

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## OPEN ELECTIVE-I
## ENGINEERING MANAGEMENT

**Course objectives:**

1. to sensitise and orient the future engineers about the challenges in managing engineering enterprises
2. to teach how to provide value through innovations, leadership in technology projects, and the application of emerging technologies through web-based tools

**Unit-I**

Introduction to Engineering Management - Management Challenges For Engineers – Planning –Organizing –Leading- Controlling-Value Engineering

**Unit-II**

Cost Accounting for Engineering Managers-Financial Accounting and Analysis for Engineering Managers- Managerial Finance for Engineering Managers

**Unit-III**

Project management – Total Quality Management –New product design – Production planning and control –Process planning – Maintenance Management – Marketing Management for Engineering Managers.

**Unit-IV**

Engineers as Managers/Leaders- Ethics In Engineering/Business Management. – Business Process Re-engineering-Ergonomics – Group Technology.

**Unit-V**

Advanced Manufacturing Technologies and systems -Web-Based Enablers For Engineering And Management- Globalization- Engineering Management In The New Millennium

**Text Book:**

1. C M Chang, Engineering Management: Challenges in the New Millennium, Pearson, 2013.

**References:**

1. Martand Telsang, Industrial Engineering and Production Management,S. Chand, Second edition.
2. A.K. Gupta, Engineering Management, S.Chand,2010.

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## MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS

**Unit I Introduction & Demand Analysis:** Definition, Nature and Scope of Managerial Economics. Demand Analysis: Demand Determinants, Law of Demand and its exceptions. *Elasticity of Demand*: Definition, Types, Measurement and Significance of Elasticity of Demand. *Demand Forecasting,* Factors governing demand forecasting, methods of demand forecasting.

**Unit II Production & Cost Analysis:** *Production Function* – Isoquants and Isocosts, MRTS, Least Cost Combination of Inputs, Cobb-Douglas Production function, Laws of Returns, Internal and External Economies of Scale. *Cost Analysis***:** Cost concepts. Break-even Analysis (BEA)-Determination of Break-Even Point (simple problems) - Managerial Significance.

**Unit III Markets & New Economic Environment:** Types of competition and Markets, Features of Perfect competition, Monopoly and Monopolistic Competition. Price-Output Determination in case of Perfect Competition and Monopoly. *Pricing*: Objectives and Policies of Pricing. Methods of Pricing. *Business:* Features and evaluation of different forms of Business Organisation: Sole Proprietorship, Partnership, Joint Stock Company, Public Enterprises and their types, *New Economic Environment*: Changing Business Environment in Post-liberalization scenario.

**Unit IV Capital Budgeting**: Capital and its significance, Types of Capital, Estimation of Fixed and Working capital requirements, Methods and sources of raising capital Trading Forecast Capital Budget, Cost Budget. Capital Budgeting: features of capital budgeting proposals, Methods of Capital Budgeting: Payback Method, Accounting Rate of Return (ARR) and Net Present Value Method (simple problems).

**Unit V Introduction to Financial Accounting & Financial Analysis:** Accounting concepts and Conventions Introduction IFRS Double-Entry Book Keeping, Journal, Ledger, Trial Balance- Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments). *Financial Analysis***:** Analysis and Interpretation of Liquidity Ratios, Activity Ratios, and Capital structure Ratios and Profitability ratios. Du Pont Chart.

**TEXT BOOKS:**

1. Aryasri: Managerial Economics and Financial Analysis, TMH, 2012.
2. Vijay Kumar & Appa Rao Managerial Ecoconomics & Financial Analysis, Cengage 2011.
3. J. V. Prabhakar Rao & P.V. Rao Managerial Ecoconomics & Financial Analysis, Maruthi Publishers, 2011.

**REFERENCES:**

1. Ambrish Gupta, Financial Accounting for Management, Pearson Education, New Delhi.2012.
2. H. Craig Peterson & W. Cris Lewis, Managerial Economics, Pearson, 2012.
3. Lipsey & Chrystel, Economics, Oxford University Press, 2009
4. Domnick Salvatore: Managerial Economics In a Global Economy, Thomson, 2012.
5. Narayanaswamy: Financial Accounting—A Managerial Perspective, PHI, 2012.
6. S.N.Maheswari & S.K. Maheswari, Financial Accounting, Vikas, 2012.
7. Truet and Truet: Managerial Economics: Analysis, Problems and Cases, Wiley, 2012.

8. Dwivedi: Managerial Economics, Vikas, 2012.
9. Kasi Reddy Sraswathi, MEFA PHI Learning, 2012.
10. Shailaja & Usha : MEFA, University Press, 2012.

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## THERMAL ENGINEERING LAB

**Pre-Requisite: Thermodynamics & Thermal Engineering - I**

**Objective:** To understand the working principles of IC Engines, Compressors, Refrigeration and Air Conditioning Systems.

Tables/Codes: Refrigeration Tables, Psychrometric Chart

Syllabus

1. Flash and Fire Points ( Open cup & Closed cup method)
2. Viscosity determination by Redwood & Saybolt methods
3. Bomb/ Junkers Gas Calorimeter.
4. I.C. Engines Valve / Port Timing Diagrams
5. I.C. Engines Performance Test for 4 Stroke SI engines
6. I.C. Engines Performance Test for 2 Stroke SI engines
7. I.C. Engines Morse, Retardation, Motoring Tests
8. I.C. Engines Heat Balance – CI/SI Engines
9. I.C. Engines Economical speed Test on a SI engine
10. I.C. Engines effect of A/F Ratio in a SI engine
11. Performance Test on Variable Compression Ratio Engine
12. IC engine Performance Test on a 4S CI Engine at constant speed
13. Performance Test on Reciprocating Air – Compressor Unit
14. Dis-assembly / Assembly of Engines
15. Study of Boilers

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## METROLOGY LAB

1. Measurement of lengths, heights, diameters by vernier calipers, micrometers.
2. Measurement of bores by internal micrometers and dial bore indicators.
3. Use of gear teeth vernier calipers for checking the chordal addendum and chordal height of the spur gear.
4. Machine tool alignment of test on the lathe.
5. Machine tool alignment test on the milling machine.
6. Tool makers microscope and its application
7. Angle and taper measurements by bevel protractor and sine bars.
8. Use of spirit level and optical flats in finding the flatness of surface plate.
9. Thread measurement by 2-wire and 3-wire methods.
10. Surface roughness measurement by Tally Surf.
11. Use of mechanical comparator
12. Use of profile projector

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## ADVANCED ENGLISH LANGUAGE COMMUNICATION SKILLS LAB

### 1. Introduction

The introduction of the Advanced Communication Skills Lab is considered essential at 3rd year level. At this stage, the students need to prepare themselves for their careers which may require them to listen to, read, speak and write in English both for their professional and interpersonal communication in the globalised context.

The proposed course should be a laboratory course to enable students to use 'good' English and perform the following:

- Gathering ideas and information to organise ideas relevantly and coherently.
- Engaging in debates.
- Participating in group discussions.
- Facing interviews.
- Writing project/research reports/technical reports.
- Making oral presentations.
- Writing formal letters.
- Transferring information from non-verbal to verbal texts and vice-versa.
- Taking part in social and professional communication.

### 2. Objectives:

This Lab focuses on using multi-media instruction for language development to meet the following targets:

- To improve the students' fluency in English, through a well-developed vocabulary and enable them to listen to English spoken at normal conversational speed by educated English speakers and respond appropriately in different socio-cultural and professional contexts.
- Further, they would be required to communicate their ideas relevantly and coherently in writing.
- To prepare all the students for their placements.

**Learning Outcomes**

- Accomplishment of sound vocabulary and its proper use contextually.
- Flair in Writing and felicity in written expression.
- Enhanced job prospects.
- Effective Speaking Abilities

### 3. Syllabus:

The following course content to conduct the activities is prescribed for the Advanced Communication Skills (ACS) Lab:

1. **Activities on Fundamentals of Inter-personal Communication and Building Vocabulary** - Starting a conversation – responding appropriately and relevantly – using the right body language – Role Play in different situations & Discourse Skills- using visuals - Synonyms and antonyms, word roots, one-word substitutes, prefixes and suffixes, study of word origin, business vocabulary, analogy, idioms and phrases, collocations & usage of vocabulary.
2. **Activities on Reading Comprehension** –General Vs Local comprehension, reading for facts, guessing meanings from context, scanning, skimming, inferring meaning, critical reading & effective googling.

3. **Activities on Writing Skills** – Structure and presentation of different types of writing – *letter writing/Resume writing/ e-correspondence/ Technical report writing/ Portfolio writing* – planning for writing – improving one's writing.
4. **Activities on Presentation Skills** – Oral presentations (individual and group) through JAM sessions/seminars/**PPTs** and written presentations through posters/projects/reports/ e-mails/assignments etc.
5. **Activities on Group Discussion and Interview Skills** – Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and organization of ideas and rubrics for evaluation- Concept and process, pre-interview planning, opening strategies, answering strategies, interview through tele-conference & video-conference and Mock Interviews.

**4. Minimum Requirement:**

The Advanced Communication Skills (ACS) Laboratory shall have the following infra-structural facilities to accommodate at least 35 students in the lab:

- Spacious room with appropriate acoustics
- Round Tables with movable chairs
- Audio-visual aids
- LCD Projector
- Public Address system
- P – IV Processor, Hard Disk – 80 GB, RAM–512 MB Minimum, Speed – 2.8 GHZ
- T. V, a digital stereo & Camcorder
- Headphones of High quality

**5. Prescribed Lab Manual:** A book titled ***A Course Book of Advanced Communication Skills (ACS) Lab*** published by Universities Press, Hyderabad.

**6. Suggested Software:**

The software consisting of the prescribed topics elaborated above should be procured and used.

- **Oxford Advanced Learner's Compass**, 8th Edition
- **DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice.**
- **Lingua TOEFL CBT Insider**, by Dreamtech
- **TOEFL & GRE** (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)
- **The following software from 'train2success.com'**
  - **Preparing for being Interviewed**
  - **Positive Thinking**
  - **Interviewing Skills**
  - **Telephone Skills**
  - **Time Management**

**7. Books Recommended:**

1. **Technical Communication** by Meenakshi Raman & Sangeeta Sharma, Oxford University Press 2009.
2. **English Language Communication : A Reader cum Lab Manual** Dr A Ramakrishna Rao, Dr G Natanam & Prof SA Sankaranarayanan, Anuradha Publications, Chennai 2008.
3. **Advanced Communication Skills Laboratory Manual** by Sudha Rani, D, Pearson Education 2011.
4. **Technical Communication** by Paul V. Anderson. 2007. Cengage Learning pvt. Ltd. New Delhi.

5. **Business and Professional Communication:** Keys for Workplace Excellence. Kelly M. Quintanilla & Shawn T. Wahl. Sage South Asia Edition. Sage Publications. 2011.
6. **The Basics of Communication: A Relational Perspective**. Steve Duck & David T. McMahan. Sage South Asia Edition. Sage Publications. 2012.
7. **English Vocabulary in Use** series, Cambridge University Press 2008.
8. **Management Shapers Series** by Universities Press(India)Pvt Ltd., Himayatnagar, Hyderabad 2008.
9. **Handbook for Technical Communication** by David A. McMurrey & Joanne Buckley. 2012. Cengage Learning.
10. **Communication Skills** by Leena Sen, PHI Learning Pvt Ltd., New Delhi, 2009.
11. **Handbook for Technical Writing** by David A McMurrey & Joanne Buckely CENGAGE Learning 2008.
12. **Job Hunting** by Colm Downes, Cambridge University Press 2008.
13. **Master Public Speaking** by Anne Nicholls, JAICO Publishing House, 2006.
14. **English for Technical Communication for Engineering Students, Aysha Vishwamohan, Tata Mc Graw-Hil 2009.**
15. Books on **TOEFL/GRE/GMAT/CAT/ IELTS** by Barron's/DELTA/Cambridge University Press.
16. **International English for Call Centres** by Barry Tomalin and Suhashini Thomas, Macmillan Publishers, 2009.

**DISTRIBUTION AND WEIGHTAGE OF MARKS**:

***Advanced Communication Skills Lab Practicals****:*

1. The practical examinations for the ACS Laboratory practice shall be conducted as per the University norms prescribed for the core engineering practical sessions.
2. For the English Language lab sessions, there shall be continuous evaluation during the year for 25 sessional marks and 50 End Examination marks. Of the 25 marks, 15 marks shall be awarded for day-to-day work and 10 marks to be awarded by conducting Internal Lab Test(s). The End Examination shall be conducted by the teacher concerned, by inviting the External Examiner from outside. In case of the non-availability of the External Examiner, other teacher of the same department can act as the External Examiner.

**Mini Project: As a part of Internal Evaluation**

**1. Seminar/ Professional Presentation**

**2. A Report on the same has to be prepared and presented.**

* ***Teachers may use their discretion to choose topics relevant and suitable to the needs of students.***

* ***Not more than two students to work on each mini project.***

* ***Students may be assessed by their performance both in oral presentation and written report.***

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### CAD / CAM

**UNIT – I**

Fundamentals of CAD,CAM, Automation , design process, Application of computers for design, Benefits of CAD, Computer configuration for CAD applications, Computer peripherals for CAD ,Design workstation, Graphic terminal, CAD software- definition of system software and application software ,CAD database and structure.

**Geometric Modeling:** 3-D wire frame modeling, wire frame entities and their definitions, Interpolation and approximation of curves, Concept of parametric and non-parametric representation of curves, Curve fitting techniques, definitions of cubic spline, Bezier, and B-spline.

**UNIT-II**

**Surface modeling:** Algebraic and geometric form, Parametric space of surface, Blending functions,parametrization of surface patch, Subdividing, Cylindrical surface, Ruled surface, Surface of revolution Spherical surface, Composite surface, Bezier surface. B-spline surface, Regenerative surface and pathological conditions.

**Solid Modelling:** Definition of cell composition and spatial occupancy enumeration, Sweep representation, Constructive solid geometry, Boundary representations.

**UNIT – III**

**NC Control Production Systems :** Numerical control, Elements of NC system, NC part programming : Methods of NC part programming, Manual part programming, Computer assisted part programming, Post Processor, Computerized part program, SPPL (A Simple Programming Language). CNC, DNC and Adaptive Control Systems.

**UNIT – IV**

**Group Technology:** Part families, Parts classification and coding. Production flow analysis, Machine cell design.

**Computer aided process planning:** Difficulties in traditional process planning, Computer aided process planning: retrieval type and generative type, Machinability data systems.

**Computer aided manufacturing resource planning:** Material resource planning, inputs to MRP, MRP output records, Benefits of MRP, Enterprise resource planning, Capacity requirements planning

**UNIT – V**

**Flexible manufacturing system**: F.M.S equipment, FMS layouts, Analysis methods for FMS benefits of FMS.

**Computer aided quality control**: Automated inspection- Off-line, On-line, contact, Non-contact; Coordinate measuring machines, Machine vision.

**Computer Integrated Manufacturing:** CIM system, Benefits of CIM

**TEXT BOOKS:**

1. CAD/CAM Principles and Applications, P.N.Rao, TMH
2. CAD/CAM Concepts and Applications, Alavala, PHI

**REFERENCE BOOKS :**

1. CAD/CAM /Groover M.P., Pearson education
2. CAD / CAM Theory and Practice,/ Ibrahim Zeid,TMH
3. CAD / CAM / CIM, Radhakrishnan and Subramanian, New Age
4. Principles of Computer Aided Design and Manufacturing, Farid Amirouche, Pearson
5. Computer Numerical Control Concepts and programming, Warren S Seames, Thomson.

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## HEAT TRANSFER

**UNIT – I**

**Introduction:** Modes and mechanisms of heat transfer – Basic laws of heat transfer – General discussion about applications of heat transfer.

**Conduction Heat Transfer:** Fourier rate equation – General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates – simplification and forms of the field equation – steady, unsteady and periodic heat transfer – Initial and boundary conditions

**One Dimensional Steady State Conduction Heat Transfer:** Homogeneous slabs, hollow cylinders and spheres- Composite systems– overall heat transfer coefficient – Electrical analogy – Critical radius of insulation

**UNIT – II**

**One Dimensional Steady State Conduction Heat Transfer:** Variable Thermal conductivity – systems with heat sources or Heat generation-Extended surface (fins) Heat Transfer – Long Fin, Fin with insulated tip and Short Fin, Application to error measurement of Temperature

**One Dimensional Transient Conduction Heat Transfer:** Systems with negligible internal resistance – Significance of Biot and Fourier Numbers –Infinite bodies- Chart solutions of transient conduction systems- Concept of Semi infinite body.

**UNIT – III**

**Convective Heat Transfer:** Classification of systems based on causation of flow, condition of flow, configuration of flow and medium of flow – Dimensional analysis as a tool for experimental investigation – Buckingham Π Theorem and method, application for developing semi – empirical non- dimensional correlation for convection heat transfer – Significance of non-dimensional numbers – Concepts of Continuity, Momentum and Energy Equations – Integral Method as approximate method -Application of Von Karman Integral Momentum Equation for flat plate with different velocity profiles.

**Forced convection: External Flows:** Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer -Flat plates and Cylinders.

**UNIT – IV**

**Internal Flows:** Concepts about Hydrodynamic and Thermal Entry Lengths – Division of internal flow based on this –Use of empirical relations for Horizontal Pipe Flow and annulus flow.

**Free Convection:** Development of Hydrodynamic and thermal boundary layer along a vertical plate - Use of empirical relations for Vertical plates and pipes.

**Heat Exchangers:** Classification of heat exchangers – overall heat transfer Coefficient and fouling factor – Concepts of LMTD and NTU methods - Problems using LMTD and NTU methods.

**UNIT V**

**Heat Transfer with Phase Change:**

**Boiling**: – Pool boiling – Regimes – Calculations on Nucleate boiling, Critical Heat flux and Film boiling

**Condensation:** Film wise and drop wise condensation –Nusselt's Theory of Condensation on a vertical plate - Film condensation on vertical and horizontal cylinders using empirical correlations.

**Radiation Heat Transfer :** Emission characteristics and laws of black-body radiation – Irradiation – total and monochromatic quantities – laws of Planck, Wien, Kirchoff, Lambert, Stefan and Boltzmann– heat exchange between two black bodies – concepts of shape factor – Emissivity – heat exchange between grey bodies – radiation shields – electrical analogy for radiation networks.

**TEXT BOOK :**

1. Fundamentals of Heat Transfer –Incropera& Dewitt/John wiley
2. Fundamentals of Enggineering,Heat & Man Transfer-R.C.Sachdeva/NewAge.
3. Heat& Man Transfer-D.S.Kumar/S.K.Kataria& sons

**REFERENCE BOOKS:**

1. Heat Transfer – A Practical Approach – Yunus Cengel, Boles / TMH
2. Heat Transfer / HOLMAN/TMH
3. Engineering Heat and Mass Transfer – Sarit K. Das / Dhanpat Rai Pub
4. Heat and Mass Transfer – R. Yadav /CPH
5. Essential Heat Transfer - Christopher A Long / Pearson Education
6. Heat Transfer-P.K.Nag /TMH
7. Heat Transfer –Ghoshdastidar/Oxford University press.

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## OPEN ELECTIVE-II
## ESTIMATION, QUANTITY SURVEY & VALUATION

**UNIT – I**

General items of work in Building – Standard Units Principles of working out quantities for detailed and abstract estimates – Approximate method of Estimating.

**UNIT – II**

Detailed Estimates of Buildings - Reinforcement bar bending and bar requirement schedules

**UNIT – III**

Earthwork for roads and canals.

**UNIT – IV**

Rate Analysis – Working out data for various items of work over head and contigent charges.

**UNIT-V**

Contracts – Types of contracts – Contract Documents – Conditions of contract, Valuation - Standard specifications for different items of building construction.

**NOTE** : NUMBER OF EXERCISES PROPOSED :

1. Three in flat Roof & one in Sloped Roof
2. Exercises on Data – three Nos.

**Text Books**

1. Estimating and Costing by B.N. Dutta, UBS publishers, 2000.
2. Estimating and Costing by G.S. Birdie

**Reference books :**

1. Standard Schedule of rates and standard data book by public works department.
2. I. S. 1200 ( Parts I to XXV – 1974/ method of measurement of building and Civil Engineering works – B.I.S.)
3. Estimation, Costing and Specifications by M. Chakraborthi; Laxmi publications.

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## OPEN ELECTIVE-II
## ENERGY STORAGE SYSTEMS

**Unit-1 Electrical Energy Storage Technologies**

Characteristics of electricity, Electricity and the roles of EES, High generation cost during peak-demand periods, Need for continuous and flexible supply, Long distance between generation and consumption, Congestion in power grids, Transmission by cable.

**Unit-2 Needs for Electrical Energy Storage**

Emerging needs for EES, More renewable energy, less fossil fuel , Smart Grid uses, The roles of electrical energy storage technologies, The roles from the viewpoint of a utility, The roles from the viewpoint of consumers, The roles from the viewpoint of generators of renewable energy.

**Unit-3 Features of Energy Storage Systems**

Classification of EES systems , Mechanical storage systems, Pumped hydro storage (PHS), Compressed air energy storage (CAES), Flywheel energy storage (FES),Electrochemical storage systems , Secondary batteries , Flow batteries, Chemical energy storage , Hydrogen (H2),Synthetic natural gas (SNG).

**Unit-4 Types of Electrical Energy Storage systems**

Electrical storage systems, Double-layer capacitors (DLC) ,Superconducting magnetic energy storage (SMES),Thermal storage systems ,Standards for EES, Technical comparison of EES technologies.

**Unit-5 Applications**

Present status of applications, Utility use (conventional power generation, grid operation & service) , Consumer use (uninterruptable power supply for large consumers), New trends in applications ,Renewable energy generation, Smart Grid, Smart Micro grid, Smart House, Electric vehicles, Management and control hierarchy of storage systems, Internal configuration of battery storage systems, External connection of EES systems , Aggregating EES systems and distributed generation (Virtual Power Plant), Battery SCADA– aggregation of many dispersed batteries.

**TEXT BOOK:**

1. ‘’Energy Storage Benefits and Market Analysis’’ by James M. Eyer, Joseph J. Iannucci and Garth P. Corey.
2. The Electrical Energy Storage by IEC Market Strategy Board.

**REFERENCE BOOKS:**

1. Jim Eyer, Garth Corey: *Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment Guide,* Report, Sandia National Laboratories, Feb 2010.

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**OPEN ELECTIVE-II**
**MECHATRONICS**

**UNIT – I**

INTRODUCTION: Definition – Trends - Control Methods: Standalone , PC Based ( Real Time Operating Systems, Graphical User Interface , Simulation ) - Applications: identification of sensors and actuators in Washing machine, Automatic Camera, Engine Management, SPM, Robot, CNC, FMS, CIM.

**SIGNAL CONDITIONING : I**ntroduction – Hardware - Digital I/O , Analog input – ADC , resolution, Filtering Noise using passive components – Registors, capacitors - Amplifying signals using OP amps –Software - Digital Signal Processing – Low pass , high pass , notch filtering

**UNIT – II**

**PRECISION MECHANICAL SYSTEMS :**

Modern CNC Machines – Design aspects in machine structures, guideways, feed drives, spindle and spindle bearings, measuring systems, control software and operator interface, gauging and tool monitoring.

**Note: (text book: Mechatronics HMT – chapter 5)**

**ELECTRONIC INTERFACE SUBSYSTEMS :** TTL, CMOS interfacing - Sensor interfacing – Actuator interfacing – solenoids , motors Isolation schemes- opto coupling, buffer IC's - Protection schemes – circuit breakers , over current sensing , resetable fuses , thermal dissipation - Power Supply - Bipolar transistors / mosfets

**UNIT – III**

**ELECTROMECHANICAL DRIVES :** Relays and Solenoids - Stepper Motors - DC brushed motors – DC brushless motors - DC servo motors - 4-quadrant servo drives , PWM's - Pulse Width Modulation – Variable Frequency Drives, Vector Drives - Drive System load calculation.

**MICROCONTROLLERS OVERVIEW** : 8051 Microcontroller , micro processor structure – Digital Interfacing - Analog Interfacing - Digital to Analog Convertors - Analog to Digital Convertors - Applications. Programming –Assembly, C ( LED Blinking , Voltage measurement using ADC).

**UNIT – IV**

PROGRAMMABLE LOGIC CONTROLLERS : Basic Structure - Programming : Ladder diagram -Timers, Internal Relays and Counters - Shift Registers - Master and Jump Controls - Data Handling -Analog input / output - PLC Selection - Application.

**UNIT – V**

**PROGRAMMABLE MOTION CONTROLLERS** : Introduction - System Transfer Function – Laplace transform and its application in analysing differential equation of a control system - Feedback Devices : Position , Velocity Sensors - Optical Incremental encoders - Proximity Sensors : Inductive , Capacitive , Infrared - Continuous and discrete processes - Control System Performance & tuning - Digital Controllers - P , PI , PID Control - Control modes – Position , Velocity and Torque - Velocity Profiles – Trapezoidal- S. Curve - Electronic Gearing - Controlled Velocity Profile - Multi axis Interpolation , PTP , Linear , Circular - Core functionalities – Home , Record position , GOTO Position - Applications : SPM, Robotics.

**TEXT BOOKS :**

1. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering by W Bolton, Pearson Education Press, 3rd edition, 2005.
2. Mechatronics/M.D.Singh/J.G.Joshi/PHI.

**REFERENCE:**

1. "Designing Intelligent Machines". open University, London.
2. Michel B. Histand and David G. Alciatore,"
3. Introduction to Mechatronics and Measurement systems, "Tata MC Graw hill
4. I. C.W. Desi ha, "Control sensors and actuators," Prentice Hall.
5. Mechatronics Source Book by Newton C Braga, Thomson Publications, Chennai.
6. Mechatronics – N. Shanmugam / Anuradha Agencies Publisers.
7. Mechatronics System Design / Devdas shetty/Richard/Thomson.

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## OPEN ELECTIVE-II
## PRINCIPLES OF COMMUNICATION SYSTEMS

**Unit 1:**
**Introduction:** Communication Systems and types, modulation and multiplexing, Electromagnetic spectrum, Gain, Attenuation and decibels.

**Unit 2:**
**Simple description on Modulation:** Analog Modulation-AM, FM, Pulse Modulation-PAM, PWM, PCM, Digital Modulation Techniques-ASK, FSK, PSK, QPSK modulation and demodulation schemes.

**Unit 3:**
**Telecommunication Systems:** Telephones Telephone system, Paging systems, Telephony.
**Networking and Local Area Networks:** Network fundamentals, LAN hardware, Ethernet LANs, Token Ring LAN.

**Unit 4:**
**Satellite Communication:** Satellite Orbits, satellite communication systems, satellite subsystems, Ground Stations Satellite Applications, Global Positioning systems.
**Optical Communication:** Optical Principles, Optical Communication Systems, Fiber –Optic Cables, Optical Transmitters & Receivers, Wavelength Division Multiplexing.

**Unit 5:**
**Multiple Access Techniques:** FDMA, TDMA, CDMA, Packet Radio techniques-ALOHA, slotted ALOHA.
**Cellular and Mobile Communications:** Cellular telephone systems, AMPS, GSM, CDMA, WCDMA.
**Wireless Technologies:** Wireless LAN, PANs and Bluetooth, ZigBee and Mesh Wireless networks, Wimax and MANs, Infrared wireless, RFID communication, UWB.

**Text Books:**
1. Principles of Electronic Communication Systems, Louis E. Frenzel, 3e, McGraw Hill publications, 2008.
2. Wayne Tomasi, Introduction to data communications and networking, Pearson Education, 2005.

**Reference Books:**
1. Tarmo Anttalainen, Introduction to Telecommunications Network Engineering, Artech House Telecommunications Library.
2. Theodore Rappaport, Wireless Communications-Principles and practice, Printice Hall, 2002.
3. Roger L. Freeman, Fundamentals of Telecommunications, 2e, Wiley publications.
4. Kennady, Davis, Electronic Communications systems, 4e, TMH, 1999.

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## OPEN ELECTIVE-II
## E-COMMERCE

**UNIT-I**

Electronic Commerce-Frame work, anatomy of E-Commerce applications, E-Commerce Consumer applications, E-Commerce organization applications.

**UNIT-II**

Consumer Oriented Electronic commerce - Mercantile Process models, Electronic payment systems - Digital Token-Based, Smart Cards, Credit Cards, Risks in Electronic Payment systems.

**UNIT-III**

Inter Organizational Commerce - EDI, EDI Implementation, Value added networks, Intra Organizational Commerce - work Flow, Automation Customization and internal Commerce, Supply chain Management.

**UNIT-IV**

Corporate Digital Library - Document Library, digital Document types, corporate Data Warehouses. Advertising and Marketing - Information based marketing, Advertising on Internet, on-line marketing process, market research.

**UNIT-V**

Consumer Search and Resource Discovery - Information search and Retrieval, Commerce Catalogues, Information Filtering, Multimedia - key multimedia concepts, Digital Video and electronic Commerce, Desktop video processings, Desktop video conferencing.

**TEXT BOOKS:**

1. Frontiers of electronic commerce – Kalakata, Whinston, Pearson.

**REFERENCE BOOKS:**

1. E-Commerce fundamentals and applications Hendry Chan, Raymond Lee, Tharam Dillon, Ellizabeth Chang, John Wiley.
2. E-Commerce, S.Jaiswal – Galgotia.
3. E-Commerce, Efrain Turbon, Jae Lee, David King, H.Michael Chang.
4. Electronic Commerce – Gary P.Schneider – Thomson.
5. E-Commerce – Business, Technology, Society, Kenneth C.Taudon, Carol Guyerico Traver.

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## OPEN ELECTIVE-II
## COMPUTER GRAPHICS

**Objectives:**
- To make students understand about fundamentals of Graphics to enable them to design animated scenes for virtual object creations.
- To make the student present the content graphically.

**Outcomes:**
- Students can animate scenes entertainment.
- Will be able work in computer aided design for content presentation..
- Better analogy data with pictorial representation.

**UNIT-I:**
**Introduction:** Application areas of Computer Graphics, overview of graphics systems, video-display devices, raster-scan systems, random scan systems, graphics monitors and work stations and input devices
**Output primitives**: Points and lines, line drawing algorithms, mid-point circle and ellipse algorithms.Filled area primitives: Scan line polygon fill algorithm, boundary-fill and flood-fill algorithms

**UNIT-II:**
**2-D geometrical transforms**: Translation, scaling, rotation, reflection and shear transformations, matrix representations and homogeneous coordinates, composite transforms, transformations between coordinate systems
**2-D viewing** : The viewing pipeline, viewing coordinate reference frame, window to view-port coordinate transformation, viewing functions, Cohen-Sutherland and Cyrus-beck line clipping algorithms, Sutherland –Hodgeman polygon clipping algorithm

**UNIT-III:**
**3-D object representation** : Polygon surfaces, quadric surfaces, spline representation, Hermite curve, Bezier curve and B-Spline curves, Bezier and B-Spline surfaces. Basic illumination models, polygon rendering methods.
**3-D Geometric transformations**: Translation, rotation, scaling, reflection and shear transformations, composite transformations.3-D viewing : Viewing pipeline, viewing coordinates, view volume and general projection transforms and clipping.

**UNIT-IV:**
**Visible surface detection methods**: Classification, back-face detection, depth-buffer, scan-line, depth sorting, BSP-tree methods, area sub-division and octree methods

**UNIT-V:**
**Computer animation**: Design of animation sequence, general computer animation functions, raster animation, computer animation languages, key frame systems, motion specifications

**Text Books:**
1. "Computer Graphics *C version*", Donald Hearn and M.Pauline Baker, Pearson Education

2. "Computer Graphics Principles & practice", second edition in C, Foley, VanDam, Feiner and Hughes, Pearson Education.

**References:**

1. Computer Graphics", second Edition, Donald Hearn and M.Pauline Baker, PHI/Pearson Education.
2. Computer Graphics Second edition", Zhigand xiang, Roy Plastock, Schaum's outlines, Tata Mc-Graw hill edition.
3. rocedural elements for Computer Graphics, David F Rogers, Tata Mc Graw hill, 2nd edition.
4. Principles of Interactive Computer Graphics", Neuman and Sproul, TMH.
5. Principles of Computer Graphics, Shalini Govil, Pai, 2005, Springer.
6. Computer Graphics, Steven Harrington, TMH

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**OPEN ELECTIVE-II**
**DATABASE MANAGEMENT SYSTEMS**

**Objectives:**

- To understand the basic concepts and the applications of database systems.
- To master the basics of SQL and construct queries using SQL.
- To understand the relational database design principles.
- To become familiar with the basic issues of transaction processing and concurrency control.
- To become familiar with database storage structures and access techniques.

**UNIT I :**

**Data base System Applications**: data base System VS file System, View of Data, Data Abstraction ,Instances and Schemas, data Models ,the ER Model, Relational Model, Other Models, Database Languages, DDL, DML, database Access for applications Programs ,data base Users and Administrator ,Transaction Management, data base System Structure, Storage Manager, the Query Processor. History of Data base Systems. Data base design and ER diagrams, Beyond ER Design Entities, Attributes and Entity sets, Relationships and Relationship sets, Additional features of ER Model ,Concept Design with the ER Model, Conceptual Design for Large enterprises.

**UNIT II:**

**Introduction to the Relational Model**: Integrity Constraint Over relations ,Enforcing Integrity constraints , Querying relational data , Logical data base Design ,Introduction to Views, Destroying /altering Tables and Views. Form of Basic SQL Query, Examples of Basic SQL Queries, Introduction to Nested Queries ,Correlated Nested Queries Set, Comparison Operators, Aggregative Operators, NULL values ,Comparison using Null values ,Logical connectivity's, AND, OR and NOT, Impact on SQL Constructs Outer Joins, Disallowing NULL values ,Complex Integrity Constraints in SQL Triggers and Active Data bases, Oracle, SQL Server,DB2.

**UNIT III:**

**Relational Algebra** :Selection and projection set operations, renaming ,Joins ,Division, Examples of Algebra overviews, Relational calculus, Tuple relational Calculus, Domain relational calculus ,Expressive Power of Algebra and calculus.

**Schema refinement**: Problems Caused by redundancy, Decompositions, Problem related to decomposition, reasoning about FDS,FIRST, SECOND, THIRD Normal forms ,BCNF, Lossless join Decomposition ,Dependency preserving Decomposition, Schema refinement in Data base Design ,Multi valued Dependencies , FORTH Normal Form, FIFTH Normal Form.

**UNIT IV:**

Transaction Concept, Transaction State, Implementation of Atomicity and Durability, Concurrent Executions , Serializability, Recoverability ,Implementation of Isolation ,Testing for serializability,Lock Based Protocols , Timestamp Based Protocols, Validation- Based Protocols ,Multiple Granularity.

Recovery and Atomicity ,Log–Based Recovery ,Recovery with Concurrent Transactions, Buffer Management, Failure with loss of nonvolatile storage, Advance Recovery systems, Remote Backup systems.

**UNIT V:**

Data on External Storage, File Organization and Indexing, Cluster Indexes, Primary and Secondary Indexes, Index data Structures ,Hash Based Indexing ,Tree base Indexing ,Comparison of File Organizations ,Indexes and Performance Tuning, Intuitions for tree Indexes, Indexed Sequential Access Methods (ISAM), B+ Trees: A Dynamic Index Structure.

**Text Books :**

1. Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, TATA McGrawHill 3rd Edition
2. Data base System Concepts, Silberschatz, Korth, McGraw hill, V edition.

**References :**

1. Data base Systems design, Implementation, and Management, Peter Rob & Carlos Coronel 7th Edition.
2. Fundamentals of Database Systems, Elmasri Navrate Pearson Education
3. Introduction to Database Systems, C.J.Date Pearson Education
4. Oracle for Professionals,The X Team,S.Shah and V.Shah,SPD.
5. Database Systems Using Oracle:A Simplified guide to SQL and PL/SQL,Shah,PHI.
6. Fundamentals of Database Management Systems, M.L.Gillenson, Wiley Student Edition.

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## OPEN ELECTIVE-II
## NANOMATERIALS

**Unit – 1**

**Introduction**

What is Nano – Why Nano – Properties at Nano Scales, Advantages & Disadvantages, Applications in comparison with bulk materials (Nanostructure, nanowires, nanotubes, nanocomposites)

**Nano Particles**

Introduction – Synthesis procedures – wet chemical approach & physical vapor synthesis approach – size effect & shape change and their properties – examples of systems involved – characterization techniques – properties & their applications

**Unit – II**

**Nano Wires**

Introduction – various synthesis procedures (template assisted method, VLS method and other synthesis methods) – properties of nanowires – characterization procedures & principles involved. Applications of Nanowires.

**Nanotubes**

Introduction – Different systems involved in nanotubes – single walled, multi-walled, Carbon based, metal incorporated tubes. Synthesis procedures (Solid & gaseous carbon source based production techniques) Growth mechanism of carbon nanotubes – properties of carbon nanotubes – characterization – applications.

**Unit – III**

**Nano Composites**

Introduction, Synthesis procedures, various systems (metal-polymer, metal-ceramics and polymer-Ceramics). Characterization – procedures – Applications.

**Unit – IV**

**Micro/Nano Fabrication Techniques**

Introduction, Basic fabrication techniques (lithography, thin film deposition and doping) MEMS fabrication techniques, Nano fabrication techniques (E-Beam nano-imprint fabrication, Epitaxy and strain engineering. Scanned probe techniques)

**Unit – V**

**Materials of Nano Technology**

Introduction – Si-based Materials - Ge-based materials - Ferro electric materials – Polymer materials - GaAs & InP (III – V) Group materials, Nano tribology and materials - characterization using Scanning Probe Microscope, AFM, FFM.

**Nano Biomaterials**

Introduction, Biocompatibility; anti bacterial activity – principles involved – Applications.

**TEXT / Reference BOOKS**

1. Nano Materials: A. K. Bandyopadyay, New age Publications
2. Nano Essentials: T. Pradeep, TMH
3. Springer Handbook of Nanotechnology
4. The Guest for new materials Auther S. T. Lakshmi Kumar, Published by Vigyan Prasar.

5. Nano – The Essentials: C – Pradeep (IIcue Professor), McGraw Hill
6. Nano Materials Synthersis, Properties and applications, 1996, Edlstein and Cammarate

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## OPEN ELECTIVE-II
## INTELLECTUAL PROPERTY RIGHTS

**Unit-I**

Introduction to Intellectual property law Basics-types of Intellectual property-Agencies responsible for intellectual property registration, internal organisations, and treaties the increasing importance of intellectual property rights. Foundation of trade mark law purpose types and function of trade mark A acquisition of trademarks rights. Selecting and evaluating the application drawing mark a mark .preparing the application drawing of marks.

**Unit-II**

Interparty proceeding, infringement, and dilution, inter parties proceedings infringement of trademarks dilution of trademarks related trade mark claims. New development in trademark law the internet protecting a domain names hyper linking and the first amendment other cyberspace trade mark issues. Applications in the United States based on foreign applications and registration.

**Unit-III**

Foundations of copyright law common law right and right under the 1976 copyright Act the united states copyright office-the subject matter of copyright, originality of material fixation of material work of authorship exclusion from copyright protection case study and activity. The right afforded by copyright law right of reproduction right to prepare derivative works copyright ownership, transfer and duration.

**Unit-IV**

Introduction foundations of patent law rights under federal law United States patent and trademark office design patents plant patents double patenting the orphan drug Act. Patent ownership and transfer sole and joint inventor's disputes over inventor ship. New developments and international patent law

**Unit-V**

The *law of trade secrets unfair competition determination of trade secret status liability for misappropriation of trade secrets employer-employee relationships protection for submissions defences to trade secret misappropriation remedies for misappropriation trade secret litigation trade secret protection programs. Intellectual property audits and due diligence reviews.*

**TEXT BOOKS:**

1. Deborah E. Bo choux : *intellectual property*, cengage learning , 2012.

**REFERENCES:**

1. P.Narayana: Intellectual property Law 3rd Edition. Eastern Law House 2001-2002.
2. Dr S.R.Myneni: law of intellectual property 2nd edition, Asian law house 2003

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## OPEN ELECTIVE-II
## ENTREPRENEURSHIP

**Aim:** The aim of this subject is to inspire students to become entrepreneurs so that they will emerge as job providers rather than job seekers.

**Learning Outcome:** By the end of this course the students should be able to understand the mindset of the entrepreneurs, identify ventures for launching, develop an idea on the legal framework and also understand strategic perspectives in entrepreneurship.

1. Understanding Entrepreneurial Mindset- The revolution impact of entrepreneurship- The evolution of entrepreneurship- Approaches to entrepreneurship- Process approach- Twenty first centaury trends in entrepreneurship.
   Case1: Ready, Aim, Fire Fire (B. Janakiram, M.Rizwana, page 212),
   Case2: Henry Ford, (B. Janakiram, M. Rizwana, page 214)
   Case 3: From candle seller to CEO (Arya Kumar P.No. 48)
2. The individual entrepreneurial mind-set and Personality- The entrepreneurial journey- Stress and the entrepreneur- the entrepreneurial ego- Entrepreneurial motivations. Corporate Entrepreneurial Mindset- the nature of corporate entrepreneur- conceptualization of corporate entrepreneurship Strategy-sustaining corporate entrepreneurship.
   Case : Globalizing Local Talent, (B. Janakiram, M. Rizwana, page 228).
3. Launching Entrepreneurial Ventures- opportunities identification- entrepreneurial Imagination and Creativity- the nature of the creativity process-Innovation and entrepreneurship. Methods to initiate Ventures- Creating new ventures-Acquiring an Established entrepreneurial venture- Franchising-hybrid- disadvantage of Franchising.
   Case 1: Water, Water everywhere: but not a drop to drink, (Richard Blundel , Page 48).
   Case 2: Critical Incident, Mark Robinson: Strategy Mapping Business (Richard Blundel, Page 48).
   Case 3: Pets.com (Arya Kumar P.No. 88)
   Case 4: creativity in start-ups (Arya Kumar P.No. 166)
   Case 5: Opportunity – Earthmoving Industry (Arya Kumar P.No. 211)
4. Legal challenges of Entrepreneurship-Intellectual property protection-Patents, Copyrights-Trade marks and Trade secrets-Avoiding trademark pitfalls. Formulation of the entrepreneurial Plan- The challenges of new venture start-ups, Poor financial Understanding-Critical factors for new venture development-The Evaluation process-Feasibility criteria approach.
   Case 1: Victoria, Tomlinson; Network. (Richard Blundel, Page 99).
   Case 2: Tim Lockett, Knowing your Customers & Suppliers (Richard Blundel Page128).
   Case 3: Google (Arya Kumar P.No. 248)
   Case 4: Tata Motors – Nano (Arya Kumar P.No. 279)
5. Strategic perspectives in entrepreneurship- Strategic planning-Strategic actions- strategic positioning-Business stabilization- Building the adaptive firms-Understanding the growth stage-Unique managerial concern of growing ventures.
   Case 1: To Lease or Not: A Cash flow Question (David H.Holt, Page 452).
   Case 2:- Public Sector - address seed capital (David H.Holt, Page 453).

**READING**

**Text Book :**

1. D F Kuratko and T V Rao “Entrepreneurship- A South-Asian Perspective “Cengage Learning, 2012.

**Cases:**

1. Arya Kumar "**Entrepreneurship- creating and leading an entrepreneurial organization " Pearson 2012.**
2. Richard Blundel" Exploring Entrepreneurship Practices and Perspectives,Oxford,2011.
3. David H Holt" Entrepreneurship:New Venture Creation" PHI,2013.

**Journal :**

1. **The Journal of Entrepreneurship,** Entrepreneurship Development Institute of India, Ahmedabad,
2. **Journal of Human Values** : IIM Calcutta.

**References:**

1. Vasant Desai "Small Scale industries and entrepreneurship" Himalaya publishing 2012.
2. Rajeev Roy "Entrepreneurship" 2e, Oxford, 2012.
3. B.Janakiram and M.Rizwana" Entrepreneurship Development :Text & Cases, Excel Books,2011.
4. Robert Hisrich et al "Entrepreneurship" 6th e, TMH, 2012.

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## AUTOMOBILE ENGINEERING
**Departmental Electives-I**

**UNIT – I**

**Introduction :** Components of four wheeler automobile – chassis and body – power unit – power transmission – rear wheel drive, front wheel drive, 4 wheel drive – types of automobile engines, engine construction – engine lubrication, splash and pressure lubrication systems, oil filters, oil pumps – crank case ventilation – engine service, reboring, decarburization, Nitriding of crank shaft..

Emission from Automobiles – Pollution standards, National and international – Pollution Control – Techniques – Noise Pollution & control.

**UNIT – II**

**Fuel System :** S.I. Engine : Fuel supply systems, Mechanical and electrical fuel pumps – carburetor – types – air filters – petrol injection.

**C.I. Engines :** Requirements of diesel injection systems, types of injection systems, fuel pump, nozzle, Alternative fuels for Automobiles-injection,Classification,Properties, Hybrid vehicles injection timing, testing of fuel, pumps.

**UNIT – III**

**Cooling System :** Cooling Requirements, Air Cooling, Liquid Cooling and Forced Circulation System – Radiators – Types – Cooling Fan - water pump, thermostat, evaporating cooling – pressure sealed cooling – antifreeze solutions.

Ignition System : Function of an ignition system, battery ignition system, constructional features of storage battery, auto transformer, contact breaker points, condenser and spark plug – Magneto coil ignition system, electronic ignition system using contact breaker, electronic ignition using contact triggers – spark advance and retard mechanism.

**UNIT – IV**

**Electrical System :** Charging circuit, generator, current – voltage regulator – starting system, bendix drive mechanism solenoid switch, lighting systems, Horn, wiper, fuel gauge – oil pressure gauge, engine temperature indicator etc.

**Transmission System :** Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel – Gear boxes, types, sliding mesh, construct mesh, synchro mesh gear boxes, epicyclic gear box , over drive torque converter.

Propeller shaft – Hoatch – Kiss drive, Torque tube drive universal joint, differential rear axles – types – wheels and tyres.

**UNIT – V**

**Steering System :** Steering geometry – camber, castor, king pin rake, combined angle toe in, center point steering. Types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism, steering gears – types, steering linkages.

**Suspension System :** Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system.

**Braking System :** Mechanical brake system, Hydraulic brake system, Master cylinder, wheel cylinder tandem master cylinder Requirement of brake fluid, Pneumatic and vacuum brakes.

**TEXT BOOKS :**

1. Automobile Engineering ,Vol. 1 & Vol. 2/ Kripal Singh
2. Automobile Engineering , Vol. 1 & Vol. 2 ,by K.M Gupta,Umesh publication

**REFERENCE BOOKS :**

1. A System approach to Automotive Technology by Jack Erjavec YesDee publishing pvt Ltd.
2. Automobile Engineering / William Crouse
3. Automotive Mechanics / Heitner
4. Alternative fuels of Automobiles by P.RamiReddy,Frontline publications.

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## NON-CONVENTIONAL SOURCES OF ENERGY
**Departmental Electives-I**

**UNIT – I**

**PRINCIPLES OF SOLAR RADIATION:** Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power - Physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, Solar radiation on titled surface, Instruments for measuring solar radiation and sun shine, solar radiation data.

**SOLAR ENERGY COLLECTION:** Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

**UNIT - II**

**SOLAR ENERGY STORAGE AND APPLICATIONS:** Different methods, sensible, latent heat and stratified storage, solar ponds. Solar applications - solar heating/cooling techniques, solar distillation and drying, Photovoltaic energy conversion.

**WIND ENERGY:** Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria

**UNIT - III**

**BIO-MASS:** Principles of Bio-Conversion, Anaerobic /aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C. Engine operation, and economic aspects.

**UNIT – IV**

**GEOTHERMAL ENERGY:** Resources, types of wells, methods of harnessing the energy, potential in India.

**OCEAN ENERGY –** OTEC, Principles, utilization, setting of OTEC plants, thermodynamic cycles. Tidal and Wave energy: Potential and conversion techniques, mini-hydel power plants, their economics.

**UNIT –V**

**DIRECT ENERGY CONVERSION:** Need for DEC, Carnot cycle, limitations, Principles of DEC. Thermo-electric generators, Seebeck, Peltier and Joule Thompson effects, figure of merit, materials, applications, MHD generators, principles, dissociation and ionization, hall effect, magnetic flux, MHD accelerator, MHD engine, power generation systems, electron gas dynamic conversion, economic aspects. Fuel cells, principle, faraday's laws, thermodynamic aspects, selection of fuels and operating conditions.

**TEXT BOOKS:**

1. Renewable Energy Resources / Tiwari and Ghosal / Narosa
2. Non- conventional Energy Sources / G.D. Rai
3. Biological Energy Resources/ Malcolm Fleischer & Chris Lawis.

**REFERENCE BOOKS:**

1. Renewable Energy Sources / Twidell & Weir
2. Solar Energy / Sukhame
3. Solar Power Engineering / B.S. Magal Frank Kreith & J.F. Kreith

4. Principles of Solar Energy / Frank Krieth & John F Kreider
5. Non-Conventional Energy / Ashok V Desai / Wiley Eastern
6. Non-Conventional Energy Systems / K Mittal / Wheeler
7. Renewable Energy Technologies / Ramesh & Kumar / Narosa

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## TRIBOLOGY
### Departmental Electives-I

**UNIT – I**

Study of various parameters: Viscosity, flow of fluids, viscosity and its variation, absolute and kinematic viscosity, temperature variation, viscosity index, determination of viscosity, different viscometers used.
Hydrostatic lubrication: Hydrostatic step bearing, application to pivoted pad thrust bearing and other applications, hydrostatic lifts, hydrostatic squeeze films and its application to journal bearing.

**UNIT – II**

Hydrodynamic theory of lubrication: Various theories of lubrication, petroffs equation, Reynold's equation in two dimensions -Effects of side leakage - Reynolds equation in three dimensions, Friction in sliding bearing, hydro-dynamic theory applied to journal bearing, minimum oil film thickness, oil whip and whirl anti -friction bearing.

**UNIT – III**

Friction and power losses in journal bearings :Calibration of friction loss, friction in concentric bearings, bearing moduIus, Sommer-field number, heat balance, practical consideration of journal bearing design considerations.

**UNIT – IV**

Air lubricated bearing: Advantages and disadvantages, application to Hydrodynamic journal bearings, hydrodynamic thrust bearings. Hydrostatic thrust bearings. Hydrostatic bearing Analysis including compressibility effect.
Study of current concepts of boundary friction and dry friction.

**UNIT-V**

Types of bearing oil pads: Hydrostatic bearing wick oiled bearings, oil rings, pressure feed bearing, partial bearings -externally pressurized bearings.
Bearing materials : General requirements of bearing materials, types of bearing materials.

**TEXT BOOK :**

1. Fundamentals of Tribology, Basu, SenGupta and Ahuja/PHI
2. Tribology in Industry : Sushil Kumar Srivatsava, S. Chand &Co.

**REFERENCE :**

1. Tribology – B.C. Majumdar

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## NEURAL NETWORKS & FUZZY LOGIC
**Departmental Electives-I**

**Unit – I**

**Introduction to Neural Networks**

Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Hodgkin-Huxley Neuron Model, Integrate-and-Fire Neuron Model, Spiking Neuron Model, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential Applications of ANN.

Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules, Types of Application

**Unit–II**

***Single Layer Feed Forward Neural Networks***

Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perceptron Networks, Perceptron Convergence theorem, Limitations of the Perceptron Model, Applications.

**Multilayer Feed forward Neural Networks**

Credit Assignment Problem, Generalized Delta Rule, Derivation of Backpropagation (BP) Training, Summary of Backpropagation Algorithm, Kolmogorov Theorem, Learning Difficulties and Improvements.

**Unit III**

**Associative Memories**

Paradigms of Associative Memory, Pattern Mathematics, Hebbian Learning, General Concepts of Associative Memory (Associative Matrix, Association Rules, Hamming Distance, The Linear Associator, Matrix Memories, Content Addressable Memory), Bidirectional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function, Proof of BAM Stability Theorem

Architecture of Hopfield Network: Discrete and Continuous versions, Storage and Recall Algorithm, Stability Analysis, Capacity of the Hopfield Network Summary and Discussion of Instance/Memory Based Learning Algorithms, Applications.

**Unit IV**

**Classical & Fuzzy Sets**

Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions.

**Fuzzy Logic System Components**

Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.

**Unit V**

**Applications: Neural network applications:** Process identification, control, fault diagnosis and load forecasting.

**Fuzzy logic applications:** Fuzzy logic control and Fuzzy classification.

**Mechanical Applications:** Washing machines, Chemical Plants Refrigeration systems, Weather Control Systems.

**TEXT BOOK:**

1. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by Rajasekharan and Rai – PHI Publication.
2. Introduction to Artificial Neural Systems - Jacek M. Zuarda, Jaico Publishing House, 1997.

**REFERENCE BOOKS:**

1. Neural and Fuzzy Systems: Foundation, Architectures and Applications, - N. Yadaiah and S. Bapi Raju, Pearson Education
2. Fuzzy Logic and Neural Networks, Alavala, New Age International
3. Neural Networks – James A Freeman and Davis Skapura, Pearson, 2002.
4. Neural Networks – Simon Hykins , Pearson Education

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## PLANT LAYOUT AND MATERIAL HANDLING
**Departmental Electives-I**

**UNIT-I**
Introduction – classification of layout, advantages and limitations of different layouts, layout design procedures, overview of plant layout.

**UNIT-II**
Process layout and product layout: selection, specification, implementation and flow up, comparison of product and process layout.

**UNIT- III**
Heuristics for plant layout- ALDEP, CORELAP, CRAFT
Group layout, fixed position layout- quadratic assignment model, branch and bound method.

**UNIT IV**
Introduction , material handling systems, material handling principles, classification of material handling equipment, relationship of material handling to plant layout.
Basic material handling systems: selection , material handling methods- path, equipment, function oriented systems,

**UNIT V**
Methods to minimize cost of material handling – maintenance of material handling equipments, safety in handling.
Ergonomics of material handling equipment. Design , miscellaneous equipments.

**TEXT BOOK:**
1. Aspects of material Handling/ Dr. KC Arora & Shinde, Lakshmi Publications.
2. Operations Management/ PB Mahapatra /PHI

**REFERENCE BOOKS:**
1. Faciliy Layout & Location an analytical approach/ RL Francis /LF Mc Linnis Jr, White / PHI
2. Production and Operations Management/ R Panneerselvam/ PHI
3. Introduction to Material handling/ Ray, Siddhartha/ New Age

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**POWER PLANT ENGINEERING**
**Departmental Electives-II**

**UNIT – I**
Introduction to the Sources of Energy – Resources and Development of Power in India.**Steam Power Plant :** Plant Layout, Working of different Circuits, Fuel and handling equipments, types of coals, coal handling, choice of handling equipment, coal storage, Ash handling systems.
**Combustion Process:** Properties of coal – overfeed and underfeed fuel beds, traveling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needs and draught system, cyclone furnace, design and construction, Dust collectors, cooling towers and heat rejection. Corrosion and feed water treatment.

**UNIT – IIInternal Combustion Engine Plant:**
DIESEL POWER PLANT: Introduction – IC Engines, types, construction– Plant layout with auxiliaries – fuel supply system, air starting equipment, lubrication and cooling system – super charging.**Gas Turbine Plant:** Introduction – classification - construction – Layout with auxiliaries – Principles of working of closed and open cycle gas turbines. Combined Cycle Power Plants and comparision.**Direct Energy Conversion:** Solar energy, Fuel cells, Thermo electric and Thermo ionic, MHD generation.

**UNIT – III**
**Hydro Electric Power Plant:** Water power – Hydrological cycle / flow measurement – drainage area characteristics – Hydrographs – storage and Pondage – classification of dams and spill ways.**Hydro Projects And Plant:** Classification – Typical layouts – plant auxiliaries – plant operation pumped storage plants.**Power From Non-Conventional Sources:** Utilization of Solar- Collectors- Principle of Working, Wind Energy – types – HAWT, VAWT -Tidal Energy.

**UNIT – IV**
**NUCLEAR POWER STATION:** Nuclear fuel – breeding and fertile materials – Nuclear reactor – reactor operation.**Types of Reactors:** Pressurized water reactor, Boiling water reactor, sodium-graphite reactor, fast Breeder Reactor, Homogeneous Reactor, Gas cooled Reactor, Radiation hazards and shielding – radioactive waste disposal.

**UNIT – V**
**Power Plant Economics And Environmental Considerations**: Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution, Load curves, load duration curve. Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor – related exercises. Effluents from power plants and Impact on environment – pollutants and pollution standards – Methods of Pollution control.

**TEXT BOOK :**
1. Power Plant Engineering – P.C.Sharma / S.K.Kataria Pub
2. A Course in Power Plant Engineering: / Arora and S. Domkundwar.

**REFERENCES :**
1. A Text Book of Power Plant Engineering / Rajput / Laxmi Publications
2. Power plant Engineering/ Ramalingam/ Scietech Publishers

3. Power Plant Engineering: P.K.Nag/ II Edition /TMH.
4. An Introduction to Power Plant Technology / G.D. Rai.
5. Power plant Engg - Elanchezhian- I.K. International Pub

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## ADVANCED MECHANICS OF COMPOSITE MATERIALS
**Departmental Electives-II**

**UNIT-I**

**Introduction to Composite Materials**: Introduction ,Classification Polymer Matrix Composites, Metal Matrix Composites, Ceramic Matrix Composites, Carbon–Carbon Composites, Fiber-Reinforced Composites and nature-made composites, and applications .

**UNIT-II**

**Reinforcements:** Fibers- Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibers. Particulate composites, Polymer composites, Thermoplastics, Thermosetts, Metal matrix and ceramic composites.

**UNIT-III**

**Macro mechanical Analysis of a Lamina**: Introduction, Definitions Stress, Strain, Elastic Moduli, Strain Energy. Hooke's Law for Different Types of Materials, Hooke's Law for a Two-Dimensional Unidirectional Lamina, Plane Stress Assumption, Relationship of Compliance and Stiffness Matrix to Engineering Elastic Constants of a Lamina.

**UNIT-IV**

**Macro mechanical Analysis of Laminates**: Introduction , Laminate Code , Stress–Strain Relations for a Laminate, In-Plane and Flexural Modulus.

**UNIT-V**

**Failure Analysis of Laminates**: Introduction, Special Cases of Laminates, Applications, Failure Criterion for a Laminate.

**Text Books:**

1. R. M. Jones, Mechanics of Composite Materials, Mc Graw Hill Company, New York, 1975.
2. Engineering Mechanics of Composite Materials by Isaac and M Daniel, Oxford University Press, 1994.

**References:**

1. B. D. Agarwal and L. J. Broutman, Analysis and performance of fibre Composites, Wiley- Interscience, New York, 1980.
2. Mechanics of Composite Materials, Second Edition (Mechanical Engineering), By Autar K. Kaw ,**Publisher:** CRC
3. L. R. Calcote, Analysis of Laminated Composite Structures, Van Nostrand Rainfold, New York, 1969.

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**PRODUCTION PLANNING AND CONTROL**
**Departmental Electives-II**

**UNIT – I**

**Introduction**: Definition – Objectives of Production Planning and Control – Functions of production planning and control - Types of production systems - Organization of production planning and control department.

**Forecasting** – Definition- uses of forecast- factors affecting the forecast- types of forecasting- their uses - general principle of forecasting. Forecasting techniques- quantitative and qualitative techniques. Measures of forecasting errors.

**UNIT – II**

**Inventory management** – Functions of inventories – relevant inventory costs – ABC analysis – VED analysis – Basic EOQ model- Inventory control systems –continuous review systems and periodic review systems, MRP I, MRP II, ERP, JIT Systems - Basic Treatment only.

**Aggregate planning –** Definition – aggregate-planning strategies – aggregate planning methods – transportation model.

**UNIT –III**

Line Balancing: Terminology, Methods of Line Balancing, RPW method, Largest Candidate method and Heuristic method.

Routing – Definition – Routing procedure – Factors affecting routing procedure, Route Sheet.

**UNIT – IV**

**Scheduling** –Definition – Scheduling Policies – types of scheduling methods – differences with loading – flow shop scheduling **–** job shop scheduling, line of balance (LOB) – objectives - steps involved.

**UNIT – V**

**Dispatching** : Definition – activities of dispatcher – dispatching procedures – various forms used in dispatching.

**Follow up** : definition – types of follow up – expediting – definition – expediting procedures- Applications of computers in planning and control.

**TEXT BOOKS:**

1. Production Planning and Control – M.Mahajan- Dhanpati rai & Co
2. Production Planning and Control- Jain & Jain – Khanna publications

**REFRENCE BOOKS :**

1. Production Planning and Control- Text & cases/ SK Mukhopadhyaya /PHI.
2. Production and operations Management – R.Panneer Selvam – PHI
3. Operations Management by Chase/PHI
4. Management Science – A R Aryasri- 4e –TMH
5. Operations management – Heizer- Pearson

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## MODERN CONTROL THEORY
**Departmental Electives-II**

**Unit-I**

**Mathematical Preliminaries:** Fields, Vectors and Vector Spaces, Linear combinations and Bases – Linear Transformations and Matrices, Scalar Product and Norms, Eigen values, Eigen Vectors and Canonical form representation of Linear operators, The concept of state, State Equations for Dynamic systems, Times Invariance and Linearity No uniqueness of stage model, State diagrams for Continuous, Time state models.

**Unit-II**

**State Variable Analysis, Controllability and Observability:**

Linear continuous time models for physical systems, Existence and uniqueness of solutions to continuous, Time state equations, solutions of linear time invariant continuous, time state equation, state transition matrix and its properties.

General concept of controllability, General concept of Observability, Controllability tests for continuous, Time Invariant systems, Controllability and Observability of state Model in Jordan Canonical form, Controllability and Observability canonical forms of state model.

**Unit-III**

**Non Linear Systems:**

Introduction, Non linear systems, Types of Non, Linearities, Saturation, Dead, Zone, Backlash, Jump Phenomenon etc;, SINGULAR POINTS, Introduction to linearization of nonlinear systems, Properties of Non linear systems, Describing function –Describing Function Analysis of Non linear systems, stability analysis of Non, linear systems through describing functions.

Introduction to phase, plan analysis, Method of Isoclines for constructing Trajectories, Singular points, Phase, plane analysis of nonlinear control systems.

**Unit-IV**

**Stability analysis of Non Linear Systems:**

Stability in the sense of Lyapunov, Lyapunov's stability and Lyapunov's instability theorems – stability Analysis of the Linear continuous time invariant systems by Lyapunov second method, Generation of Lyapunov Functions, Variable Gradient Method – Krasooviski's method. Static feedback controllers and Observers, State feedback controller design through pole assignment, state observers: Full order and Reduced order.

**Unit-V**

**Optimal Control:**

Introduction to optimal control, Formulation of optimal control Problems, calculus of variations, fundamental concepts, functionals, variations of functionals, fundamental theorem of Calculus of variations – boundary conditions- constrained minimization- formulation using Hamiltonian method- Linear Quadratic regulator.

**Text Books**

1. Modern control system theory by M. Gopal- New Age International- 1984
2. Modern Control Engineering by Ogata.K- Prentice Hall- 1997

**References:**

1. Optimal control by Kircks

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**FLUID POWER SYSTEMS**
**Departmental Electives-II**

**UNIT I INTRODUCTION**
Need for Automation, comparison with other power systems-ISO symbols for fluid power elements-Economic consideration of fluid power systems-Oil hydraulics, pneumatic-introduction and selection criterion.

**UNIT II HYDRAULIC POWER GENERATION, CONTROL AND REGULATING ELEMENTS**
Basic elements in a fluid power system-Hydraulic pumps, Gear, Vane, piston-selection and specification, drive characteristics Hydraulic actuators-Linear and Rotary, selection specification and characteristics, cushioning.

**UNIT III PNEUMATICS AND ELECTRO PNEUMATICS**
Generation and control of compressed air-Elements in pneumatic circuits, Fluidic devices and its applications Flip-Flop, SRT Flip flop-Use of electrical switches, relays, timers in fluid power circuits-
Electro pneumatics.

**UNIT IV CIRCUIT DESIGN**
Design and methodology-sequential circuits, cascade, Karnaugh-Veitch map, step counter methods-Compound and combination circuit design. Typical Industrial and hydraulic circuits-Synchronising and accumulator circuits-Circuits for machine tools-Aerospace application-Design and selection criteria. Electro pneumatic circuit design, Ladder diagram.

**UNIT V COMPUTER CONTROL & MAINTENANCE OF FLUID POWER CIRCUITS**
Fuzzy logic in fluid power circuits-PLC in fluid powers-PLC ladder diagram. Installation-Fault diagnosis in fluid power circuits.

**REFERENCES:**
1. A.B Goodnain. Fluid Power systems, Me Millian Press Ltd, 1976
2. McCloy and Martin H.R., The Control of Fluid Power, Longman Publications. 1973

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## KINEMATICS AND DYNAMICS LABORATORY

(A Minimum of 10 experiments are to be conducted)

**Experiments:**

1. Determination of damped natural frequency of vibration of the vibrating system with different viscous oils.
2. Determination of steady state amplitude of a forced vibratory system.
3. Static balancing using steel balls.
4. Determination of the magnitude and orientation of the balancing mass in dynamic balancing.
5. Field balancing of the thin rotors using vibration pickups.
6. Determination of the magnitude of gyroscopic couple, angular velocity of precession and representation of vectors.
7. Determination of natural frequency of given structure using FFT analyzer.
8. Diagnosis of a machine using FFT analyzer.
9. Direct Kinematic analysis of a robot.
10. Inverse Kinematic analysis of a robot.
11. Trajectory planning of a robot in joint space scheme.
12. Palletizing operation using Robot programming.

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## HEAT TRANSFER LAB

1. Composite Slab Apparatus – Overall heat transfer co-efficient.
2. Heat transfer through lagged pipe.
3. Heat Transfer through a Concentric Sphere
4. Thermal Conductivity of given metal rod.
5. Heat transfer in pin-fin
6. Experiment on Transient Heat Conduction
7. Heat transfer in forced convection apparatus.
8. Heat transfer in natural convection
9. Parallel and counter flow heat exchanger.
10. Emissivity apparatus.
11. Stefan Boltzman Apparatus.
12. Heat transfer in drop and film wise condensation.
13. Critical Heat flux apparatus.
14. Study of heat pipe and its demonstration.

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## COMPUTER AIDED ENGINEERING LAB

**Perform any 12 Experiments.**

1. Drafting: Development of part drawings for various components in the form of orthographic and isometric. Representation of dimensioning and tolerances.
2. Part Modeling:Generation of various 3D Models through Protrusion, revolve, sweep. Creation of various features. Study of parent child relation. Feature based and Boolean based modeling and Assembly Modeling. Study of various standard Translators. Design of simple components.
3. Determination of deflections, principal and Von-mises stresses in plane stress, plane strain and Axi-symmetric components.
4. Determination of stresses in 3D and shell structures (at least one example in each case)
5. Study state heat transfer analysis of plane and axi-symmetric components.
6. Truss analysis using FEA software
7. Beam analysis using FEA software
8. Frame analysis using FEA software
9. Buckling analysis using FEA software
10. Harmonic analysis using FEA software
11. Fracture analysis using FEA software
12. Analysis of laminated composite using FEA software
13. Coupled field analysis using FEA software
14. Model analysis
15. Transient dynamic analysis
16. Unsteady-state heat transfer analysis for 2-dimensional problems.
17. Steady-state and uniform flow analysis.

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## DISASTER MANAGEMENT

**UNIT 1 : Understanding Disaster**
Concept of Disaster
Different approaches
Concept of Risk
Levels of Disasters
Disaster Phenomena and Events (Global, national and regional)
**Hazards and Vulnerability**
Natural and man-made hazards; response time, frequency and forewarning levels of different hazards
Characteristics and damage potential or natural hazards; hazard assessment
Dimensions of vulnerability factors; vulnerability assessment
Vulnerability and disaster risk
Vulnerabilities to flood and earthquake hazards

**UNIT 2 : Disaster Management Mechanism**
Concepts of risk management and crisis managements
Disaster Management Cycle
Response and Recovery
Development, Prevention, Mitigation and Preparedness
Planning for Relief

**UNIT 3: Capacity Building**
Capacity Building: Concept
Structural and Nonstructural Measures
Capacity Assessment; Strengthening Capacity for Reducing Risk
Counter-Disaster Resources and their utility in Disaster Management
Legislative Support at the state and national levels

**UNIT 4: Coping with Disaster**
Coping Strategies; alternative adjustment processes
Changing Concepts of disaster management
Industrial Safety Plan; Safety norms and survival kits
Mass media and disaster management

**UNIT 5: Planning for disaster management**
Strategies for disaster management planning
Steps for formulating a disaster risk reduction plan
Disaster management Act and Policy in India
Organizational structure for disaster management in India
Preparation of state and district disaster management plans

**Text Books**
1. Alexander, D. Natural Disasters, ULC press Ltd, London, 1993.
2. Carter, W.N. Disaster Management: A Disaster Management Handbook, Asian Development Bank, Bangkok, 1991.
3. Manual on Natural Disaster Management in India, NCDM, New Delhi, 2001.

**References**

1. Abarquez I. & Murshed Z. Community Based Disaster Risk Management: Field Practitioner's Handbook, ADPC, Bangkok, 2004.
2. Goudie, A. Geomorphological Techniques, Unwin Hyman, London 1990.
3. Goswami, S.C Remote Sensing Application in North East India, Purbanchal Prakesh, Guwahati, 1997.
4. Chakrabarty, U.K. Industrial Disaster Management and Emergency Response, Asian Book Pvt. Ltd., Delhi 2007.
5. Disaster Management in India, Ministry of Home Affairs, Government of India, New Delhi, 2011.
6. National Policy on Disaster Management, NDMA, New Delhi, 2009
7. Disaster Management Act. (2005), Ministry of Home Affairs, Government of India, New Delhi, 2005.
8. District Disaster Management Plan-Model Template, NIDM, New Delhi, 2005.
9. Disaster Management, Future challenge and opportunities, Edited by Jagbir singh, I.K. International publishing home Pvt, Ltd.

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**PRINCIPLES OF SIGNAL PROCESSING**
**(PGC)**

**UNIT I:**
**Fourier Transform:**
Fourier transform and relation between Fourier series and Fourier transform (F.T), Properties of Fourier Transform, Conditions for existence of F.T, Linear system, Impulse response, Response of a linear system, Linear time invariant (LTI) system, Transfer function of a LTI system, Filter characteristics of linear systems, Distortionless transmission through a system, Physical Realizability of LTI systems
**Z-Transform (Z.T):** Concept of Z.T, Properties of Z-Transform, Region of Convergence, Inverse Z-Transform, Solution to difference equations, Relation between F.T, L.T and Z.T, Problems.

**UNIT II:**
**Discrete Time Fourier Transform**
Discrete Time (DT) signals and sequences, Properties of DT LTI system- Linearity, Time invariance, Stability, Causality, Memoryless, Linear Constant Coefficient Difference Equations and its solution, Concept of Discrete Time Fourier Transform (DTFT), Frequency domain representation of discrete time signals and systems, Properties of DTFT, Problems

**UNIT III:**
**Discrete Fourier representation**
**Discrete Fourier Series (DFS):** DFS representation of periodic sequences, Properties, Problems
**Discrete Fourier Transform (DFT):** Discrete Fourier Transform, Properties of DFT, Linear convolution of sequences using DFT, Computation of DFT, Relation between DTFT, DFS, Z.T and DFT, Problems, computation of DFT using FFT-DIT, Inverse FFT

**UNIT IV:**
**IIR Digital Filters:** Analog filter approximations – Butterworth and Chebyshev, Design of IIR Digital filters from Analog filters- Impulse Invariance and Bilinear Transformation techniques, Design Examples, Realization of IIR filters in Direct, Canonic forms

**UNIT V:**
**FIR Digital Filters:** Characteristics of FIR Digital Filters, Frequency response, Design of FIR Digital Filters - Fourier method, Window Techniques (using rectangular, Hanning and Hamming windows) Frequency Sampling technique, Comparison of IIR & FIR filters, Realization of FIR filters in Direct, Canonic forms

**TEXT BOOKS:**
1. Signals, Systems & Communications - B.P. Lathi, BS Publications, 2009.
2. Digital Time Signal Processing – A. V. Oppenheim and R. W. Schaffer, J. R. Buck, Pearson Education, 2009
3. Fundaments of Digital Signal Processing – Loney Ludeman, John Wiley, 2010

**REFERENCES:**

1. Signals and Systems - A.V. Oppenheim, A.S. Wilsky and S.H. Nawab, PHI, 2nd Edn, 2008
2. Digital Signal Processing – S.Salivahan, A. Vallavaraj and C.GnanaPriya, TMH, 2008
3. Digital Signal Processing, Principles, Algorithms, and Applications: John G. Proakis, Dimitris G. Manolakis, Pearson Education / PHI, 2007.
4. Digital Signal Processing – Fundaments and Applications – Li Tan, Elsevier, 2008
5. Digital Signal Processing – A Practical Approach, Emmanuel C. Ifeachor and Barrie W. Jervis, 2nd Edition, Pearson Education, 2009.

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## INDUSTRIAL ROBOTICS
## (PGE-I)

**UNIT I:**

Introduction: Automation and Robotics, Robot anatomy, robot configuration, motions joint notation work volume, robot drive system, control system and dynamic performance, precision of movement.

CONTROL SYSTEM AND COMPONENTS: basic concepts and models; controllers control system analysis, robot actuators and feedback components (Sensors): Internal & External Sensors, Position Sensors, Velocity sensors – Desirable features, tactile, proximity and range sensors, uses of sensors in robotics, Power Transmission Systems.

**UNIT II:**

MOTION ANALYSIS AND CONTROL: Manipulator Kinematics, position representation, Homogeneous transformation, D-H Notation, D-H Transformation Matrix, Forward & Inverse transformations, problems on planar & spatial manipulators, Differential Kinematics, Jacobian Formulation, Problems, manipulator path control: Slew, Joint Interpolated & Straight line motions, trajectory planning: Joint space scheme, Cartesian space scheme, Cubic Polynomial fit without and with via point, blending.

**UNIT III:**

ROBOT DYNAMICS: Lagrange – Euler & Newton Euler formulations, problems on two link planar manipulators, configuration of robot controller.

END EFFECTORS: Grippers –types, operation, mechanism, force analysis, tools as end effectors consideration in gripper selection and design.

MACHINE VISION: Functions, Sensing and Digitizing-imaging, Devices, Lighting techniques, Analog to digital single conversion, Image storage, Image Processing and Analysis-image data reduction, Segmentation feature extraction. Object recognition, training the vision system, Robotics application.

**UNIT-IV:**

**ROBOT PROGRAMMING:** Lead through programming, Robot programming as a path in space, Motion interpolation, WAIT, SIGNAL AND DELAY commands, Branching capabilities and Limitations.

ROBOT LANGUAGES: Textual robot languages, Generation, Robot language structures, Elements and functions.

UNIT – V:

ROBOT CELL DESIGN AND CONTROL: Robot Cell layouts-Robot centered cell, In-line robot cell, Considerations in work cell design , Work cell control, Inter locks, Error etection, Work cell controller.

ROBOT APPLICATIONS: Material transfer, Machine loading/unloading, Processing operations, Assembly and Inspection, Future Applications.

**TEXT BOOKS:**

1. Introduction to Robotics Mechatronics & Control/ John J. Craig/Pearson
2. Industrial robotics/ Mikell P. Groover/Mc Graw Hill.
3. Theory of Applied Robotics/ Jazan Springer

**REFERENCES:**

1. Robotics / K.S.FU /Mc Graw Hill.
2. Robot Analysis/Lung Wen T sai/ John Wiley & Sons.
3. Robotics & Control/ RK Mittal & IJ Nagrath/ Tata Mc Graw Hill.
4. Fundamentals of Robotics/Robert J.Schilling/PHI
5. Robotics by saha/TMG
6. Robotic Engineering/Richard D. Klafter, Thomas A. Chemielewski/PHI
7. Modelling and Control of Robot Manipulators/ L. Sciavicco & B. Sicliano/ Springer

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## FRACTURE MECHANICS
## (PGE-I)

Prerequisite: none

Course Outcomes: At the end of the course the students will be able to

- Predict material failure for any combination of applied stresses.
- Estimate failure conditions of a structure
- Determine the stress intensity factor for simple components of simple geometry
- Predict the likelihood of failure of a structure containing a defect

**UNIT I:**

**Introduction to fracture Mechanics**: The Crack Tip Plastic Zone, Methods for Measuring Fracture Toughness.

**UNIT II:**

Strength of cracked bodies- potential energy and surface energy – Griffith's theory – Irwin – Orwin extension of Griffith's theory to ductile materials – Stress analysis of cracked bodies – Effect of thickness on fracture toughness – Stress intensity factors for typical geometries.

**UNIT III:**

**PHYSICAL ASPECTS OF FATIGUE:**

Phase in fatigue life - Crack initiation – Crack growth - Final fracture - Dislocation – Fatigue fracture surfaces. Safe Life and Fail safe design philosophies Importance of Fracture Mechanics in Aerospace structure – Applications to composite materials and structures.

**UNIT IV:**

**STATICAL ASPECTS OF FATIGUE BEHAVIOUR:**

Low cycle and high cycle fatigue - Coffin- Manson's Relation –Transition Life – Cyclic strain hardening and softening – Analysis of load histories – Cycle counting techniques – Cumulative damage – Miner's theory, other theories.

**UNIT V:**

Dynamic Fracture, Stress Corrosion Cracking, Corrosion Fatigue, Fatigue - Crack Propagation under Variable - Amplitude Load Fluctuation, Fatigue - Crack Initiation, Fatigue - Crack Propagation under Constant - Amplitude Load Fluctuation.

**Text Books**:

1. Introduction to Fracture Mechanics - Hellan K, McGraw Hill
2. Fracture Vol II – Liebowitz, H.Editor, Academic Press
3. The Practical Use of Fracture Mechanics – Broek.D, Kluwer Academic Publisher.
4. Elementary Engineering Fracture Mechanics IV th Edition– Broek.D, Martinus Nijhoff.

**References:**

1. Barrpos. W., and Ripley, E.L., " Fatigue of Aircraft Structures", Pergamon Press, Oxford, 1983.
2. Sih, C.G., "Mechanics of Fracture", Vol. 1 Sijthoff and Noordhoff International Publishing Co., Netherlands, 1989.
3. Knott , J.F., " Fundamentals of Fracture Mechanics", Butterworth & Co., (Publishers) Ltd., London. 1983

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## EXPERIMENTAL STRESS ANALYSIS
## (PGE-I)

Prerequisite: none

Course Outcomes: At the end of the course the students will be able to

- Know the working principle of strain gauges and do the model analysis using different theorems.
- Know the concepts of photo elasticity and its applications.
- Use the various Non-destructive testing methods.

**UNIT-I**

Strain Gauges - Mechanical and optical strain gauges – Description and operation – Electrical resistance- Inductance and capacitance gauges – Detailed treatment on resistant gauges – Measurement of static and dynamic strains – Strain rosettes – Effect of transverse strains – Use of strain recorders and load cells.

**UNIT-II**

Model Analysis - Structural similitude – Use of models – Structural and dimensional analysis – Buckingham Pi Theorem – Muller Breslau's principle for indirect model analysis – Use of Begg's and Eney's deformeters – Moment indicators – Design of models for direct and indirect analysis.

**Unit-III**

Two dimensional photo elasticity - Stress optic law – Introduction to polariscope – Plane and circular polariscope – Compensators and model materials – Material and model fringe value – Calibration of photo elastic materials – Isochromatic and isoclinic fringes – Time edge effects.

**Unit-IV**

Three dimensional photo elasticity - Introduction – Stress freezing techniques – Stress separation techniques – Scattered light photo elasticity – Reflection polariscope.

**Unit-V**

Miscellaneous Methods - Brittle coating method – Birefringence techniques – Moire fringe method – Non-destructive testing – Ultrasonic pulse velocity technique – Rebound hammer method – X-ray method – Gamma-ray method.

**Text books :**

1. Experimental stress analysis by Dally and Riley, Mc Graw-Hill

**References:**

1. Experimental stress analysis by Sadhu singh, Danapathi rai publications
2. Heteny M; Handbook of Experimental Stress Analysis, John Wiley and Sons, New York.
3. Photoelasticity Vol. I & II., Frocht M.M.; John Wiley and Sons, New York

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## ADVANCED MECHANICS OF SOLIDS
## (PGE-I)

Prerequisite: Applied Mechanics, mechanics of solids

Course outcomes: After completing this course, the student should be able to

- Determined the point of location of applied load to avoid twisting in thin sections used in aerospace applications.
- Understand the concept of distinguish between neutral and centroidal axes in curved beams.
- Understanding the analogy models developed for analyzing the non circular bars subjected to torsion, and also analyzing the stresses developed between rolling bodies and stress in three dimensional bodies.

**Unit –I:**
**Shear center:** Bending axis and shear center-shear center for axi-symmetric and unsymmetrical sections.
**Unsymmetrical bending:** Bending stresses in Beams subjected to Nonsymmetrical bending, Deflection of straight beams due to nonsymmetrical bending.

**Unit –II:**
**Curved beam theory:** Winkler Bach formula for circumferential stress – Limitations – Correction factors –Radial stress in curved beams – closed ring subjected to concentrated and uniform loads-stresses in chain links.

**Unit –III:**
**Torsion :** Linear elastic solution Prandtl elastic membrane (Soap-Film) Analogy; Narrow rectangular cross Section, Hollow thin wall torsion members, Multiply connected Cross Section.

**Unit –IV:**
**Contact stresses:** Introduction, problem of determining contact stresses, Assumptions on which a solution for contact stresses is based; Expressions for principal stresses; Method of computing contact stresses, Deflection of bodies in point contact; Stresses for two bodies in contact over narrow rectangular area (Line contact) Loads normal to area, Stresses for two bodies in line contact, Normal and Tangent to contact area.

**Unit –V:**
**Introduction to Three Dimensional Problems:** Uniform stress stretching of a prismatical bar by its own weight twist of circular shafts of constant cross section, pure bending of plates.

**Textbooks:**
1.Advanced Mechanics of materials by Boresi & Sidebottom-Wiely International.
2. Theory of elasticity by Timoschenko S.P. and Goodier J.N. McGraw-Hill Publishers 3rd Edition

**References:**
1. Advanced strength of materials by Den Hortog J.P.

2. Theory of plates – Timoshenko.
3. Strength of materials & Theory of structures (Vol I & II) by B.C Punmia
4. Strength of materials by Sadhu singh

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# MECHATRONICS
## (PGE-II)

**UNIT-I**

**INTRODUCTION:** Definition – Trends – Control Methods Standalone, PC Based ( Real Time Operating Systems, Graphical User Interface , Simulation ) – Applications: SPM, Robot, CNC, FMS, CIM.

**SIGNAL CONDITIONING:** Introduction – Hardware – Digital I/O , Analog input – ADC, resolution , Filtering Noise using passive components – Registors, Capacitors – Amplifying signals using OP amps – Software – Digital Signal Processing – Low pass. High pass , notch filtering

**UNIT –II**

**PRECISION MECHANICAL SYSTEMS:** Pneumatic Actuation Systems – Electro – pneumatic Actuation Systems – Hydraulic Actuation Systems – Electro-hydraulic Actuation Systems – Timing Belts – Ball Screw and Nut – Linear Motion Guides – Linear Bearings – Harmonic Transmission – Bearings – Motor / Drive Selection.

**ELECTRONIC INTERFACE SUBSYSTEMS**: TTL, CMOS interfacing – Sensor interfacing – Actuator interfacing – Solenoids, motors Isolation schemes –opto coupling, buffer IC's – Protection schemes – circuit breakers , over current sensing, resettable fuses, thermal dissipation – power Supply – Bipolar transistors / mosfets

**UNIT-III**

**ELECTROMECHANICAL DRIVES:** Relays and Solenoids – Stepper Motors – DC brushed motors – DC brushless motors – DC Servo motors - 4- quadrant servo drives , PWM's – Pulse Width Modulation – Variable Frequency Drives, Vector Drives – Drive System load calculation.

**MICROCONTROLLERS OVERVIEW:** 8051 Microcontroller, micro processor structure – Digital Interfacing – Analog Interfacing – Digital to Analog Convertors – Analog to Digital Convertors – Applications. Programming – Assembly, C (LED Blinking, Voltage measurement using ADC).

**UNTI-IV**

**PROGRAMMABLE LOGIC CONTROLLERS:** Basic Structure – Programming : Ladder diagram – Timers, Internal Relays and Counters – Shift Registers – Master and Jump Controls – Data Handling – Analog input/ output – PLC Selection – Application.

**UNIT – V**

**PROGRAMMABLE MOTION CONTROLLERS:** Introduction – System Transfer Function – Laplace transform and it s application in analysing differential equation of a control system – Feedback Devices : Position , Velocity Sensors – Optical Incremental encoders – Proximity Sensors : Inductive , Capacitive , Infrared – Continuous and discrete processes – Control System Performance & tuning – Digital Controllers – P, PI , PID Control – Control – Control modes – Position , Velocity and Torque – Velocity Profiles – Trapezoidal- S. Curve – Electronic Gearing – Controlled Velocity Profile- Multi axis

Interpolation, PTP, Linear, Circular – Core functionalities – Home , Record position, GOTO Position – Applications : SPM, Robotics.

**TEXT BOOKS:**

1. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering by W Bolton, Pearson Education Press, 3rd edition, 2005.
2. Mechatronics/M.D.Singh/J.G.Joshi/PHI.

**REFERENCES:**

1. Mechatronics Source Book by Newton C Braga, Thomson Publications, Chennai.
2. Mechatronics – N. Shanmugam / Anuradha Agencies Publisers.
3. Mechatronics System Design/Devdasshetty/Richard/Thomson.

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**IV Year B.Tech./M. Tech.ECE I-Semester**

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## VEHICLE DYNAMICS
## (PGE-II)

Prerequisite: Automobile Engineering

Course Outcomes: At the end of the course the students will be able to

- The focus of Automotive System Dynamics is to introduce the fundamentals of vehicle dynamics and the performance indices and evaluation criteria of vehicles, to analyze the influence of vehicle configuration and design parameters on vehicle performance.

**UNIT I:**
**Introduction**: Fundamental Principles, Vehicle tires performance, cornering characteristics, Mechanics of Vehicle Terrain interaction. Vehicle Kinematics, Fundamental principles of velocity, acceleration. Two dimensional mechanisms, Forward Vehicle Dynamics.

**UNIT II:**
Three dimensional Mechanisms, Multi-Body Systems Design, Introduction to 3D vehicle design.

**UNIT III:**
**Suspension Design:** Computer models using Bond Graph Technology, Drive train dynamics, vehicle performance

**UNIT IV:**
**Steering Mechanisms**: Two and three dimensional analysis, Mechanics of Vehicle Terrain interaction. Vehicle Collations, Fundamental laws of motion, energy and momentum, Forces and Moments 2D and 3D. The Dynamics of vehicle rollovers.

**UNIT V:**
Wheeled Vehicle Handling – Handling control loop, vehicle transfer function, Kinematic behavior of vehicles with rigid wheels and with complaint tyres: Neutral steer point, static margin, over and under-steer. Solution with two degree of freedom in the steady state: Stability factor, characteristic and critical speeds. Tracked Vehicle Handling – Analysis of sprocket torques and speeds, required to skid steer a tracked vehicle. Extension of theory to include three degrees of freedom.

**Text Books:**
1. Vehicle Dynamics Theory and Application- Reza Jazar, Springer 2008
2. Theory of Ground Vehicles – J.Y.Wong, John Wiley.

**References:**
1. Vehicle stability – Dean Karnopp, Dekker Mechanical Engineering
2. Modeling & Simulation of Mechatronics Systems – Karnoop Margolis, Rosenberg, Wiley 2007.
3. Suspension and Tyres - Giles J.G. Steering, Illiffe Books Ltd., London.
4. Fundamental of Vehicle Dynamics- Gillespie T.D, SAE USA.

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**IV Year B.Tech./M. Tech.ECE I-Semester**

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## RANDOM VIBRATIONS
## (PGE-II)

Prerequisites: Probability & Statistics, Kinematic of machinery and Dynamics of machinery.

Course outcome: After completing this course, students should be able to

- Apply tools from probabilistic modeling to analyze dynamic systems while accounting for variability and uncertainties that are inevitably present in real engineered systems.
- Classify random excitations as stationary or non-stationary•
- Discuss important properties of random processes•
- Define and compute power spectral density functions •
- Compute auto-and cross-correlation functions, and relate them to power spectral•
- Density functions Describe the dynamic response of a multi-degree-of-freedom system to a• stochastic excitation
- Quantify the distributions of peak loads and peak responses from a system subject• to stochastic excitation

**UNIT I**
**PROBABILITY THEORY:**
Random Vibrations - Probability distribution and density functions - Excreted values - Conditional probability - Characteristic and log characteristic functions - Chebycshev inequality - Functions of random variables.

**UNIT - II**
**RANDOM PROCESSES - I:**
Concept of stationary and ergodicity - Evolutionary nonostationary process - Auto and cross correlation and covariance Functions - Mean square limit, differentiability and inerrability - Spectral decomposition.

**UNIT III**
**RANDOM PROCESSES - II:**
Power spectral and cross spectral density Factions - Wiener - Khintchine relations - Properties of Gaussian. Poisson and Markov processes –Fokker - Planck Equation - Broad band and narrow band random processes - white noise.

**UNIT IV**
**RANDOM VIBRATIONS - I:**
Response of linear single and multi - degree of freedom systems to stationary excitation - Response of continuous systems - Normal mode method.

**UNIT V**
**RANDOM VIBRATIONS - II:**
Level crossing, peak and envelop statistics - First excursion and fatigue.

**Text Books :**

1. Lishakoff, I., " Probabilistic Methods in the Theory of Structures", John Wiley, New York, 1983.

2. Newland, D.E., " An Introduction to Random Vibrations and Spectral Analysis", Longman Inc., New York, Second Edition, 1984.

**References:**

1. Nigam, N.C., "Introduction to Random Vibrations". MIT Press, Cambridge, Massachusettes, 1983
2. Nigam, N.C. and Narayanan, S., "Applications of Random Vibrations", Narosa Publications,1995

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**IV Year B.Tech./M. Tech.ECE I-Semester**

| L | T | P | C |
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| 4 | 0 | 0 | 4 |

## THEORY OF ELASTICITY
## (PGE-II)

Prerequisite: Mechanics of solids

Course outcomes: After completing this course, the student should be able to

- Analyse the stresses and strains for two dimensional and three dimensional elements.
- Understand the equilibrium and compatibility conditions.
- Solve the problems on Torsion for different shaped bars.

**UNIT-I**

**Introduction:** Elasticity – notation for forces and stress components of stresses - components of strain - Hooks law. Plane Stress and plain strain analysis - plane stress - plane strain-differential equations of equilibrium - boundary conditions – compatibility equations –stress function - boundary condition.

**UNIT-II**

Two dimensional problems in rectangular co-ordinates-solution by polynomials - saint-vanant's principle-determination of displacements-bending of simple beams-application of corier series for two dimensional problems-gravity loading.

**UNIT-III**

Two dimensional problems in polar coordinates - stress distribution symmetrical about an axis - pure bending of curved bars - strain components in polar coordinates – displacements - displacement for symmetrical stress distribution - simple symmetric and asymmetric problems - general solution of two-dimensional problem in polar coordinates - application of general solution in polar coordinates.

**UNIT-IV**

Analysis of stress and strain in three dimensions - principal stress - stress ellipsoid - director surface - determination of principal stresses - max shear stresses - homogeneous deformation - principal axes of strain rotation. General Theorems. Differential equations of equilibrium - conditions of compatibility - determination of displacement - equations of equilibrium in terms of displacements - principle of super position - uniqueness of solutions - the reciprocal theorem.

**UNIT- V**

Torsion of Prismatic Bars - torsion of prismatic bars - bars with elliptical cross sections - other elementary solution - membrane analogy - torsion of rectangular bars-solution of torsional problems by energy method - use of soap films in solving torsion problem - hydro dynamical analogies - torsion of shafts, tubes, bars etc.

**UNIT-V**

Theory of plasticity: Introduction - concepts and assumptions - yield criterions.

**Text Books:**

1. Theory of Elasticity by Timeshanko, McGrawhill Publications

**References:**

1. Theory of Elasticity by Y.C. Fung.
2. Theory of Elasticity by Sadhu Singh. Dhanpat Rai sons Private Limited, New Delhi

**JNTUH COLLEGE OF ENGINEERING HYDERABAD**

**IV Year B.Tech./M. Tech.ECE I-Semester**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 4 | 4 |

## STRUCTURAL MECHANICS & ROBOTICS LAB

*STRUCTURAL MECHANICS*

1. Determination of deflection, principal and Von-mises stresses in plane stress, plane strain and Axi-symmetric components.
2. Determination of stresses in 3D and shell structures (at least one example in each case)
3. Study state heat transfer analysis of plane and axi-symmetric components.
4. Truss analysis using FEA software.
5. Beam analysis using FEA software.
6. Frame analysis using FEA software.
7. Buckling analysis using FEA software.
8. Harmonic analysis using FEA software.
9. Fracture analysis using FEA software.
10. Analysis of laminated composite using FEA software.
11. Coupled field analysis using FEA software.
12. Modal analysis
13. Transient dynamic analysis

*ROBOTICS LAB*

14. Experiments using Programmable Motion Controller, Programmable Logic
15. Controller, DC Servo Motor and Optical Incremental Encoder.
16. Experiments using Conveyor and X-Y position table.
17. Writing and running robot programs using Robo-X.
18. Experiments using limit switch, optical sensor, read sensor, inductive proximity sensor. Thermocouple and RTD.
19. Experiments using Pneumatic systems.
20. Operation of SCARA Robot.
21. Demonstration of Automation work cell used for tablet manufacturing.

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**Blekinge Institute of Technology**
Department of Mechanical Engineering

# COURSE SYLLABUS

# Forskningsmetodik med inriktning mot ingenjörsvetenskap

## Research Methodology with Emphasis on Engineering Science

## 7,5 ECTS credit points (7,5 högskolepoäng)

**Course code:** MT2521
**Educational level:** Advanced level
**Course level:** A1F
**Field of education:** Technology
**Subject group:** Mechanical Engineering

**Subject area:** Mechanical Engineering
**Version:** 1
**Applies from:** 2013-07-01
**Approved:** 2013-04-30
**Replaces course syllabus approved:** 2011-06-17

**1 Course title and credit points**
The course is titled Research Methodology with Emphasis on Engineering Science/Forskningsmetodik med inriktning mot ingenjörsvetenskap and awards 7,5 ECTS credits. One credit point (högskolepoäng) corresponds to one credit point in the European Credit Transfer System (ECTS).

**2 Decision and approval**
This course is established by Department of Mechanical Engineering 2013-04-30. The course syllabus is approved by School of Engineering and applies from 2013-07-01.
Reg.no: BTH 4.1.1-0345-2013. Replaces MT2511.

**3 Objectives**
The goal of the course is to give a fundamental introduction to modern approach to science, particularly to nature and engineering sciences. The course gives also an insight on history and philosophy of science and how the scientific methods could be applied in electrical and mechanical engineering. After the course the students should be able to curry on research projects and write a scientific report.

**4 Content**
**PART 1: Theory, 2.5 ECTS credits**
• History of science. A way from experience facts to experimentalism and bring up questions at issues as observations, experimental attempt, induction and deduction.
• Modern theory of science: falsificationism, Kuhn's paradigm, Lakato's research programmes, Feyerabend's anarchistic theory of science, subjective Bayesians, and new experimentalism.
• Principle of scientific methods.
• How to organise and write thesis/scientific report
• Legal and ethical aspects of research.
• Modern search tools for scientific sources.
**PART 2: Project/Seminar, 5 ECTS credits**
• Approaching research problem - a research question and hypothesis
• Validation and verification of research hypothesis
• Content of research report
• Using journal and conference templates
• Presenting and disputing of research results
• Reviewing of the research reports.
• Project management – project plan, milestones and deliveries
• Team work management

**5 Aims and learning outcomes**
After the course the students should be able to: •have understanding for fundamental concept and theory concerning modern paradigm in science, special in natural and engineering sciences
•have a knowledge in scientific history and philosophy
•apply scientific methods within engineering •write, present and dispute scientific papers and reports
•analyse, review and oppose scientific papers and reports

•use search tools and sources to base the research on scientific content
•cooperate within a project group and apply project management tools.

**6 Generic skills**
The following skills are practiced
• Scientific writing.
• Analysis and synthesis ability.
• Research competence.

**7 Learning and teaching**
The teaching comprises lectures, group assignments and seminars.
Education and its contents will in extent be aimed against needs that arise at practice of the enginetrade.
The teaching language is English.

**8 Assessment and grading**
***Examination of the course***

| Code | Module | Credit | Grade |
|---|---|---|---|
| 1310 | Written examination | 2.5 ECTS | A-F |
| 1320 | Project | 5 ECTS | G-U |

The course will be graded A Excellent, B Very good, C Good, D Satisfactory, E Sufficient, FX Insufficient, supplementation required, F Fail. Examinations can happen continuously during the course, by test at the end of the course or through a combination of these two forms.
Examinations can be oral and/or written.
In order to get grade 3 or higher the student has to show clearly that the faith spirit objectives been achieved.
If grade Fx are given, the student may after consultation with the course coordinator / examiner get an opportunity to within 6 weeks complement to grade E for the specific course element.

**9 Course evaluation**
The course coordinator is responsible for systematically gathering feedback from the students in course evaluations and making sure that the results of these feed back into the development of the course.

**10 Prerequisites**
Completed studies of at least 180 credits in the field of technology.

**11 Field of education and subject area**
The course is part of the field of education Technology and is included in the subject area Mechanical Engineering.
The course can also be included in the subject area Electrical Engineering.

**12 Restrictions regarding degree**
The course cannot form part of a degree with another course, the content of which completely or partly corresponds with the contents of this course.

**13 Course literature and other teaching material Compulsory literature**:
A.F. Chalmers: *What is this Thing Called Science?*
ISBN 0-87220-452-9.
Compendia (provided by a teacher) Internet
Data basis
**Complementary literature**:
A.F. Chalmers. *Vadärvetenskapegentligen? Om väsenoch status hos vetenskapenochdessmetoder*. ISBN-10:9157804257.
Graziano, A.M., Raulin, M.L. *Research Methods. AProcess on Inquiry*. ISBN 0-205-51221-6.
Samir Okasa. *Philosophy of Science; A Very ShortIntroduction*. ISBN 978-0-19-280283-5.
Wayne C Booth, Gregory G Colomb, Joseph M Williams: *Craft of Research*. ISBN 9780226065663.
Wayne C Booth, Gregory G Colomb, Joseph M Williams. *Forskningochskrivande: konstenattskrivaenkeltocheffektivt*. ISBN 9789144032276.
■

**Blekinge Institute of Technology**
Department of Mechanical Engineering

# COURSE SYLLABUS

# Strukturanalys

## Structural Analysis

## 7,5 ECTS credit points (7,5 högskolepoäng)

**Course code:** MT2529
**Educational level:** Advanced level
**Course level:** A1N
**Field of education:** Technology
**Subject group:** Mechanical Engineering

**Subject area:** Mechanical Engineering
**Version:** 2
**Applies from:** 2013-11-20
**Approved:** 2013-11-20
**Replaces course syllabus approved:** 2009-11-01

**1 Course title and credit points**
The course is titled Structural Analysis/Strukturanalys and awards 7,5 ECTS credits. One credit point (högskolepoäng) corresponds to one credit point in the European Credit Transfer System (ECTS).

**2 Decision and approval**
This course is established by Department of Mechanical Engineering 2013-11-20. The course syllabus was revised by School of Engineering and applies from 2013-11-20.
Reg.no: BTH 4.1.1-0838-2013. Replaces MT2415.

**3 Objectives**
The course shall provide knowledge and proficiency of fundamental methods and tools for computational and experimental structural analysis to support design decisions in product development.
•apply Fourier and Laplace transforms in a mechanical context.

**4 Content**
The product development process, prototyping, virtual and physical modeling, simulation and experimentation.
Approximate methods in engineering, algorithms and programming.
Software for technical calculations, introduction to MATLAB.
Physical phenomena treated as signals. Mathematical methods, Fourier and Laplace transforms.

**5 Aims and learning outcomes**
On completion of the course the student will be able to:
•use MATLAB to create useful functions for Structural Analysis.
•apply basic signal processing tools on mechanical signals.

**6 Generic skills**
The following generic skills are trained in the course:
• analytical thinking
• systematic approach to a problem

**7 Learning and teaching**
The teaching is in English, using lectures, demonstrations and assignments. The individually submitted assignments are discussed in close relation with the student until full understanding is reached.

**8 Assessment and grading**
***Examination of the course***

| Code | Module | Credit | Grade |
|---|---|---|---|
| 1405 | Written test | 3 ECTS | A-F |
| 1415 | Assignments[1] | 4.5 ECTS | G-U |

[1] To get final credits for the course all assignments must be passed.
The course will be graded A Excellent, B Very good, C Good, D Satisfactory, E Sufficient, FX Insufficient, supplementation required, F Fail.If grade FX or UX are given, the student may after consultation with the course coordinator / examiner get an opportunity to within 6 weeks complement to grade E or G for the specific course element.

**9 Course evaluation**
The course coordinator is responsible for systematically gathering feedback from the students in course evaluations and making sure that the results of these feed back into the development of the course.

**10 Prerequisites**

Bachelor of Science in Mechanical Engineering.

**11 Field of education and subject area**
The course is part of the field of education and is included in the subject area Mechanical Engineering.

**12 Restrictions regarding degree**
The course cannot form part of a degree with another course, the content of which completely or partly corresponds with the contents of this course.

**13 Course literature and other teaching material**
Broman G.: Computational Engineering, Department of Mechanical Engineering, Blekinge Institute of Technology, 2003.
Lindfield G. and Penny J.: Numerical Methods Using Matlab, Ellis Horwood, 2000.
Brandt A.: Introductory Noise & Vibration Analysis, SavenEduTech AB and Department of Telecommunications and Signal Processing, Blekinge Institute of Technology, 2001.
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**Blekinge Institute of Technology**
Department of Mechanical Engineering

# COURSE SYLLABUS

# Mekanikensapproximativaberäkningsmetoder 1

## Computational Engineering 1

## 7,5 ECTS credit points (7,5 högskolepoäng)

**Course code:** MT2526
**Educational level:** Advanced level
**Course level:** A1N
**Field of education:** Technology
**Subject group:** Mechanical Engineering

**Subject area:** Mechanical Engineering
**Version:** 1
**Applies from:** 2014-01-01
**Approved:** 2013-12-18
**Replaces course syllabus approved:** 2009-11-01

**1 Course title and credit points**
The course is titled Computational Engineering 1/Mekanikensapproximativaberäkningsmetoder 1 and awards 7,5 ECTS credits. One credit point (högskolepoäng) corresponds to one credit point in the European Credit Transfer System (ECTS).

**2 Decision and approval**
This course is established by Department of Mechanical Engineering 2013-12-18. The course syllabus is approved by School of Engineering and applies from 2014-01-01.
Reg.no: BTH 4.1.1-0975-2013. Replaces MT2405.

**3 Objectives**
The students gain knowledge and skills of semi-analytical and numerical calculation methods for extensive engineering analysis in e.g. the product development process. Engineering Tribology, Heat Conduction and Solid Mechanics are the primary fields of application used for introduction of the calculation methods in the course. The students will develop skills in creating theoretical models, deriving relevant equations and solving equations by appropriate methods. This will give deepened understanding of how existing calculation software works and of their possibilities and limitations. The ability to develop complementary software for special purposes will also be increased. Searching for scientific information and communicating scientific facts and relationships will be thoroughly practiced.

**4 Content**
This course focuses on one-dimensional problems and gives an introduction and the fundamental theory and skills needed for the continuation course Computational Engineering 2.
The topics covered are described by the keywords below:
Numerical Solution of Ordinary Differential Equations, Initial Value Problems, The Euler Method, The Modified Euler Method, The Trapezoidal Method, The Midpoint Method, Richardson Extrapolation, Runge-Kutta methods, Multi-step Methods, Systems of Ordinary Differential Equations, Boundary Value Problems, The Shooting Method, The Finite Difference Method, Weighted Residual Methods, The Finite Element Method, One-dimensional Element Types, Shape Functions and Weight Functions, Transient Problems, Time Marching Schemes, Explicit Integration, Implicit Integration, Nonlinear Problems, Algorithms and Programming, Errors andConvergency, Commercial Computation Software, Fluid Lubrication Theory, Lubricant Characteristics, Environmental Aspects of Lubricants, Heat Transfer Theory, Solid Mechanics Theory, Nondimensional Quantities.

**5 Aims and learning outcomes**
On completion of the course the student will be able to:
•derive a governing one-dimensional differential equation for a given initial or boundary value problem
•solve the given types of equations with specified analytical or numerical methods.
•interpret, validate and communicate calculated results

**6 Generic skills**

The following generic skills are trained in the course:
• analytical reasoning
• scientific and engineering practise
• ability to work in teams
• oral and written presentation

**7 Learning and teaching**
Lectures/seminars will be given on the course content.
A number of specified calculation problems will be solved individually and a minor assignment will be solved in groups by the students to facilitate the learning of the theory. The students will develop computer codes for the numerical solution methods necessary to solve the problems given. Advantages and disadvantages of the methods will be discussed in the light of this experience.

**8 Assessment and grading**
***Examination of the course***

| Code | Module | Credit | Grade |
|---|---|---|---|
| 1405 | Assignment | 4 ECTS | A-F |
| 1415 | Written test | 3.5 ECTS | A-F |

The course will be graded A Excellent, B Very good, C Good, D Satisfactory, E Sufficient, FX Insufficient, supplementation required, F Fail.If grade FX are given, the student may after consultation with the course coordinator / examiner get an opportunity to within 6 weeks complement to grade E for the specific course element.

**9 Course evaluation**
The course coordinator is responsible for systematically gathering feedback from the students in course evaluations and making sure that the results of these feed back into the development of the course.

**10 Prerequisites**
Bachelor of Science in Mechanical Engineering.

**11 Field of education and subject area**
The course is part of the field of education Technology and is included in the subject area Mechanical Engineering.

**12 Restrictions regarding degree**
The course cannot form part of a degree with another course, the content of which completely or partly corresponds with the contents of this course.

**13 Course literature and other teaching material**
• Broman G.: Computational Engineering, Department of Mechanical Engineering, Blekinge Institute of Technology, 2003.
• Ottosen N. S. and Petersson H.: Introduction to the Finite Element Method, Prentice Hall, 1992.
• Lindfield G. and Penny J.: Numerical Methods Using Matlab, Ellis Horwood, 2000.
• Complementary literature from e.g. the University Library.
■

**Blekinge Institute of Technology**
Department of Applied Signal Processing

# COURSE SYLLABUS

# Ljud- och vibrations analys

## Sound and Vibration Analysis

## 7,5 ECTS credit points (7,5 högskolepoäng)

**Course code:** ET2545
**Educational level:** Advanced level
**Course level:** A1N
**Field of education:** Technology
**Subject group:** Electrical Engineering

**Subject area:** Electrical Engineering
**Version:** 2
**Applies from:** 2014-01-01
**Approved:** 2013-12-18
**Replaces course syllabus approved:** 2012-02-14

**1 Course title and credit points**
The course is titled Sound and Vibration Analysis/Ljud- ochvibrationsanalys and awards 7,5 ECTS credits. One credit point (högskolepoäng) corresponds to one credit point in the European Credit Transfer System (ECTS).

**2 Decision and approval**
This course is established by Department for Electrical Engineering 2013-12-18. The course syllabus was revised by School of Engineering and applies from 2014-01-01.
Reg.no: BTH 4.1.1-0963-2013. Replaces ET2529.

**3 Objectives**
The course aims at giving the students basic knowledge of sound- and vibration measurements. The course also reflects how modern signal analysis is applied for the measuring of sound and vibrations. The student will be well prepared for sound- and vibration measuring within the industry as well as for continued studies in the subject.

**4 Content**
· Mechanical systems
· Transducers for noise and vibration analysis
· Frequency analysis
· Experimental frequency analysis
· Spectrum estimation using the FFT
· The FFT-analyzer
· Frequency response measurements
· Rotating machinery analysis

**5 Aims and learning outcomes**
On completion of the course the student will:
• be able to understand and use the basic theory for dynamic systems in mechanics.
• have acquired a basic understanding of modal analysis.
• be able to understand and analyze measurement-technical problems in sound- and vibration measuring.
• have knowledge of different measuring methods and sensors that are used for the measuring of sound and vibrations.
• be able to measure and interpret sound- and vibration spectra.
• be able to measure frequency responses and coherence functions.
• be able to use a frequency analyzer.
• have acquired a basic understanding of revolution-per-minute (RPM) analysis in order to understand and solve vibration- and noise problems in relation to rotating machines.

**6 Generic skills**
The following generic skills are trained in the course:
• Skill in analysis and synthesis
• Skill in applying the knowledge in practice
• Solution of problems
• Team working
• Academic writing

**7 Learning and teaching**
The teaching comprises lectures and project work. During the lectures the teacher introduces the theoretical foundations and connects the theory to practical applications in the industry. In the project work the student is able to practise the theoretically acquired knowledge and learn how to handle data acquisition systems and advanced measuring instruments for sound- and vibration measurements. The project work is compulsory and will be carried out individually or in a group. The project work includes the presentation of the work in the form of a report. In order for the student to practise theory, theoretical assignments are handed in. The assignments that are handed in are compulsory and must be done individually.
The teaching language is English.

**8 Assessment and grading**
***Examination of the course***

| Code | Module | Credit | Grade |
|---|---|---|---|
| 1405 | Written exam[1] | 3.5 ECTS | A-F |
| 1415 | Project | 3 ECTS | G-U |
| 1425 | Assignment | 1 ECTS | G-U |

1 Determines the final grade for the course, which will only be issued when all components have been approved.
The course will be graded A Excellent, B Very good, C Good, D Satisfactory, E Sufficient, FX Insufficient, supplementation required, F Fail.If grade FX or UX are given, the student may after consultation with the course coordinator / examiner get an opportunity to within 6 weeks complement to grade E or G for the specific course element.
1 Determines the final grade for the course which will not be issued until all items have been passed. The examination will take place through a written examination and of the handing in of the compulsory assignments and of the project work assignments. Grading of the project work assignments will be done through the grades Godkänd [Passed] or Underkänd [Failed]. For a final grade of the course the grade Godkänd [Passed] is required for the project work part and also for the assignments that are to be handed in.
Upon request grades may also be given in accordance with the ECTS.

**9 Course evaluation**
The course coordinator is responsible for systematically gathering feedback from the students in course evaluations and making sure that the results of these feed back into the development of the course.

**10 Prerequisites**
For admission to the course the following course is required:
- Signal Processing I, ET1203, 7,5 credit points or the equivalent.

**11 Field of education and subject area**
The course is part of the field of education and is included in the subject area Electrical Engineering.

**12 Restrictions regarding degree**
The course cannot form part of a degree with another course, the content of which completely or partly corresponds with the contents of this course.

**13 Additional information**
The course can also be linked to Mechanical Engineering.

**14 Course literature and other teaching material**
Brandt, A. (2011). *Noise and Vibration Analysis.* Wiley. ISBN 978-0-470-74644-8.
■

**Blekinge Institute of Technology**
Department of Mechanical Engineering

# COURSE SYLLABUS

# Mekanikensapproximativaberäkningsmetoder 2

## Computational Engineering 2

## 15 ECTS credit points (15 högskolepoäng)

**Course code:** MT2527
**Educational level:** Advanced level
**Course level:** A1F
**Field of education:** Technology
**Subject group:** Mechanical Engineering

**Subject area:** Mechanical Engineering
**Version:** 1
**Applies from:** 2013-07-01
**Approved:** 2013-04-30
**Replaces course syllabus approved:** 2009-11-01

**1 Course title and credit points**
The course is titled Computational Engineering 2/Mekanikensapproximativaberäkningsmetoder 2 and awards 15 ECTS credits. One credit point (högskolepoäng) corresponds to one credit point in the European Credit Transfer System (ECTS).

**2 Decision and approval**
This course is established by Department of Mechanical Engineering 2013-04-30. The course syllabus is approved by School of Engineering and applies from 2013-07-01.
Reg.no: BTH 4.1.1-0346-2013. Replaces MT2408.

**3 Objectives**
The students gain knowledge and skills of semi-analytical and numerical calculation methods for extensive engineering analysis in e.g. the product development process. Engineering Tribology, Heat Conduction and Solid Mechanics are the primary fields of application used for introduction of the calculation methods in the course. The students will develop skills in creating theoretical models, deriving relevant equations and solving equations by appropriate methods. This will give deepened understanding of how existing calculation software works and of their possibilities and limitations. The ability to develop complementary software for special purposes will also be increased. Searching for scientific information and communicating scientific facts and relationships will be thoroughly practiced.

**4 Content**
This course builds on the course Computational Engineering 1 and extends on multi-dimensional problems. The topics covered are described by the keywords below:
Numerical Solution of Partial Differential Equations,Boundary Value Problems, The Method of VariableSeparation, Analogy Methods, The Finite Difference Method, Boundary Adjustments, The Finite Element Method, Two- and Three-dimensional Element Types, Shape Functions and Weight Functions, Approximate Mapping, Isoparametric Elements, Meshing and Nodal numbering, Gauss' Integration, Transient Problems, Time Marching Schemes, Explicit Integration, Implicit Integration, Nonlinear Problems, Material Models, Large Displacements, Newton and Quasi-Newton Iteration Schemes, Commercial Computation Software, Fluid Lubrication Theory, Lubricant Characteristics, Environmental Aspects of Lubricants, Heat Transfer Theory, Solid Mechanics Theory, Nondimensional Quantities.

**5 Aims and learning outcomes**
On completion of the course the student will be able to:
•derive governing multi-dimensional nonlinear coupled differential equations for a given initial and/or boundary value problem
•solve the given types of equations with specified semi-analytical or numerical methods. •interpret, validate and present calculated results

**6 Generic skills**
The following generic skills are trained in the course:
• analytical reasoning

• scientific and engineering practise
• ability to work in teams
• oral and written presentation

**7 Learning and teaching**
Lectures/seminars will be given on the course content.
A number of specified calculation problems will be solved individually and a major assignment will be solved in groups by the students to facilitate thelearning of the theory. The students will develop computer codes for the numerical solution methods necessary to solve the problems given. Advantages and disadvantages of the methods will be discussed in the light of this experience.

**8 Assessment and grading**
***Examination of the course***

| Code | Module | Credit | Grade |
|---|---|---|---|
| 1310 | Assignment | 7.5 ECTS | A-F |
| 1320 | Written test (week exam) | 7.5 ECTS | A-F |

The course will be graded A Excellent, B Very good, C Good, D Satisfactory, E Sufficient, FX Insufficient, supplementation required, F Fail.If grade Fx are given, the student may after consultation with the course coordinator / examiner get an opportunity to within 6 weeks complement to grade E for the specific course element.

**9 Course evaluation**
The course coordinator is responsible for systematically gathering feedback from the students in course evaluations and making sure that the results of these feed back into the development of the course.

**10 Prerequisites**
MT2405 Computational Engineering 1.

**11 Field of education and subject area**
The course is part of the field of education and is included in the subject area Mechanical Engineering.

**12 Restrictions regarding degree**
The course cannot form part of a degree with another course, the content of which completely or partly corresponds with the contents of this course.

**13 Course literature and other teaching material**
• Broman G.: Computational Engineering, Department of Mechanical Engineering, Blekinge Institute of Technology, 2003.
• Ottosen N. S. and Petersson H.: Introduction to the Finite Element Method, Prentice Hall, 1992.
• Lindfield G. and Penny J.: Numerical Methods Using Matlab, Ellis Horwood, 2000.
• Complementary literature from e.g. the University Library.
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**Blekinge Institute of Technology**
Department of Applied Signal Processing

# COURSE SYLLABUS

# Experimentellmodalanalys

## Experimental Modal Analysis

## 7,5 ECTS credit points (7,5 högskolepoäng)

**Course code:** ET2544
**Educational level:** Advanced level
**Course level:** A1F
**Field of education:** Technology
**Subject group:** Electrical Engineering

**Subject area:** Electrical Engineering
**Version:** 3
**Applies from:** 2013-07-01
**Approved:** 2013-04-30
**Replaces course syllabus approved:** 2012-02-14

**1 Course title and credit points**
The course is titled Experimental Modal Analysis/Experimentellmodalanalys and awards 7,5 ECTS credits. One credit point (högskolepoäng) corresponds to one credit point in the European Credit Transfer System (ECTS).

**2 Decision and approval**
This course is established by Department for Electrical Engineering 2013-04-30. The course syllabus was revised by School of Engineering and applies from 2013-07-01.
Reg.no: BTH 4.1.1-0318-2013. The course replaces ET2528.

**3 Objectives**
The course shall provide knowledge and proficiency of fundamental methods and tools for characterization of mechanical structures, including experimental modal analysis and system simulation.

**4 Content**
· Single and multiple degrees of freedom systems
· The modal concept in analytical and matrix formulation
· Damping models
· Modal parameters and Frequency Response Function connection
· Practical aspects on Frequency Response Function measurements
· Modal parameter extraction
· Multiple references
· Structural modification, Substructure coupling
· Correlation with Finite Element Analysis

**5 Aims and learning outcomes**
On completion of the course the student will be able to:
•specify an experimental modal analysis on mechanical structures.
•perform experimental modal analysis on
mechanical structures, including selection and mounting of transducers, selection and mounting of an exciter, data acquisition and parameter extraction.
•perform simulations of mechanical systems using parameters from numerical models and/or experiments, for example concerning influence from applied loads and/or simple structural changes. •use modern software for structural mechanics, including modal parameter extraction, structural modification and correlation with Finite Element Analysis.

**6 Generic skills**
The following generic skills are trained in the course:
•Capacity for analysis and synthesis •Capacity for applying knowledge in practice •Problem solving
•Academic writing

**7 Learning and teaching**
The teaching consists of lectures and projectwork.In order to further explain the theory and it´s applications there is a compulsory project task. The project work is compulsory and must be carried in groups. A written report to account for the work forms part of the project task.

**8 Assessment and grading**
*Examination of the course*

| Code | Module | Credit | Grade |
|---|---|---|---|
| | Written exam[1] | 3.5 ECTS | A-F |
| | Project | 3 ECTS | G-U |
| | Assignment | 1 ECTS | G-U |

1 Determines the final grade for the course, which will only be issued when all components have been approved.
The course will be graded A Excellent, B Very good, C Good, D Satisfactory, E Sufficient, FX Insufficient,supplementation required, F Fail.The examination is done through a written exam together with a report of the compulsory project work assignments. For a final grade of the course, the grade of Pass is required for the project part. The final grade will be the same as the examination grade.
If grade FX are given, the student may after consultation with the course coordinator / examiner get an opportunity to within 6 weeks complement to grade E for the specific course element.

**9 Course evaluation**
The course coordinator is responsible for systematically gathering feedback from the students in course evaluations and making sure that the results of these feed back into the development of the course.

**10 Prerequisites**
Required cours for admission to this course: ET2529 Sound and Vibration Analysis, 7,5 credit points.

**11 Field of education and subject area**
The course is part of the field of education and is included in the subject area Electrical Engineering.

**12 Restrictions regarding degree**
The course cannot form part of a degree with another course, the content of which completely or partly corresponds with the contents of this course.

**13 Additional information**
In addition to the prerequisites for the course it is recommended to haven the course Signal Processing II, ET1303 or the equivalent.
The course can also be included in the Mechanical Engineering field.

**14 Course literature and other teaching material**
Brandt, A. (2011) Noise and Vibration Analysis, Wiley ISBN 978-0-470-74644-8
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