Mahindra Ecole Centrale
Bahadurpally, Hyderabad-

ACADEMIC REGULATIONS FOR

4 YEAR DEGREE PROGRAM

(B.Tech.)

(With effect from 2014-15 Academic Year)

1) 4 Year B. Tech degree:

Mahindra Ecole Centrale (MEC) offers 4 years (8 semesters) B.Tech in the following: Branches of Engineering, with effect from the Academic Year 2014-15 onwards.

<table>
<thead>
<tr>
<th>S. No</th>
<th>B.Tech</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mechanical</td>
</tr>
<tr>
<td>2</td>
<td>Computer Science and Engineering</td>
</tr>
<tr>
<td>3</td>
<td>Civil Engineering</td>
</tr>
<tr>
<td>4</td>
<td>Electrical Engineering</td>
</tr>
</tbody>
</table>

A student would be conferred the B.Tech. Degree, after the successful completion of all the requirements for the 8 semesters of study and earning the appropriate credits. The B.Tech degree is awarded by Jawaharlal Nehru Technological University (JNTU)- Hyderabad for the four year engineering course. Proposals have been made to provide students the option of continuing their education for the fifth year for which there would be recognition from French Statutory bodies.

2) 4 Year B. Tech Structure :

2.1 MEC’s mission is to train highly qualified polyvalent Engineers, at the top of Science and Technology, who are able to tackle the XXIst century's complex challenges in an innovative way. MEC believes in the progress for the benefit of Human Kind and Society, thus:

- MEC Engineers implement Science and Technology to benefit Human Kind, Society, Companies and Organizations;
- MEC Engineers are Leaders, Entrepreneurs and Innovators, acting for change and development;
MEC Engineers are integrators of technology, system architects and project managers, able to design and manage complex systems, in their multiple dimensions such as technological, economical, human and environmental.

Therefore, the MEC Curriculum aims to:

- Enable student master knowledge in Fundamental Sciences, Engineering Sciences and Social and Human Sciences, together with the development of competencies, skills and abilities;
- Develop a system-approach to Complexity;
- Expose the students to Research and Companies;
- Help students practice case-based and problem-based learning in the framework of team projects;
- Enable students to experience International and inter-cultural contexts.

MEC develops training which respects the following key criteria:

- Development of a strong basis in Fundamental Sciences to promote analytic thinking, abstraction and concept-oriented mind, giving the students the ability to question and experiment and master modern technological tools. This criterion will be evaluated within the Fundamental Sciences syllabus, particularly in Mathematics and Physics.

- Diversity in Engineering Sciences in order to develop a system-approach and the ability to enter dialogue with technological and scientific specialists. This criterion will be evaluated within the Engineering Sciences syllabus and the cross-disciplinary activities.

- In addition, complementary courses in Business and Management, Social and Human Sciences, Culture and Language (esp. English and French); this criterion will be evaluated on the full syllabus.

- Concrete practice with experimental learning, case based learning, applied courses, project works and internships.

- An innovative approach to the societal challenges and a close relationship with Research.

- Employability development and a close relationship with the corporate world, via visits, conferences, internships, to promote the development of soft skills and professional best practices. This criterion will be evaluated by the involvement of non-academic trainers.

- Work in an international and multi-cultural context (case studies, and outgoing mobility, international teams). This criterion will be evaluated by the multi-cultural activities, the numbers of international students in exchange, the mobility of the local students, the duration of their mobility, and the number of international faculty and staff.
Diversity in the curriculum allowing all the students to find their own way in the domain of professional activities (research, entrepreneurship, management, operations, marketing, etc.) and the field of activities (industry, services, national organizations).

<table>
<thead>
<tr>
<th>S.NO.</th>
<th>UG Program</th>
<th>Group/Category/Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>UG</td>
<td>PH - Physics</td>
<td>Includes courses in Physics</td>
</tr>
<tr>
<td>2</td>
<td>UG</td>
<td>MA – Mathematics</td>
<td>Includes s courses in Mathematics</td>
</tr>
<tr>
<td>3</td>
<td>UG</td>
<td>EE - Electrical Engineering</td>
<td>Includes the courses of Electrical Engineering</td>
</tr>
<tr>
<td>4</td>
<td>UG</td>
<td>ME – Mechanical Engineering</td>
<td>Includes the courses in Mechanical Engineering</td>
</tr>
<tr>
<td>5</td>
<td>UG</td>
<td>SE – Sciences of Enterprise</td>
<td>Includes the courses Media, Industrial Engineering, management and finance etc.</td>
</tr>
<tr>
<td>6</td>
<td>UG</td>
<td>HS – Humanities and Social Sciences</td>
<td>courses on Language, philosophy, sociology etc.</td>
</tr>
<tr>
<td>7</td>
<td>UG</td>
<td>CB - Chemistry and Biology</td>
<td>Includes courses in Chemistry and Biology.</td>
</tr>
<tr>
<td>8</td>
<td>UG</td>
<td>CS – Computer Science</td>
<td>courses related to computer science and technology</td>
</tr>
<tr>
<td>9</td>
<td>UG</td>
<td>ME – Mechanical Engineering</td>
<td>courses related to Mechanical Engineering</td>
</tr>
<tr>
<td>11</td>
<td>UG</td>
<td>E – Elective Course</td>
<td>A specialization course in common UG Part of all disciplines</td>
</tr>
<tr>
<td>12</td>
<td>UG</td>
<td>CE – Civil Engineering</td>
<td>Courses related to Civil Engineering</td>
</tr>
<tr>
<td>14</td>
<td>UG</td>
<td>D – Departmental courses</td>
<td>Specialization Courses in respective disciplines i.e. Mechanical, Computer Science, Electrical, Civil</td>
</tr>
</tbody>
</table>
2.2 Each Subject, Lab, Project, Industrial Training /Seminar Comprehensive Viva etc. has specified credits, as indicated in the Course Structure. The Credit requirement for 4 Year B.Tech. is: 172 Credits.

2.3 The minimum Instruction Days for each semester shall be around 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 weighted as one credit in general.

2.4 There shall be no branch transfer at UG level. This is subject to the reservations of the MEC management.

2.5 The 4 Year B.Tech. shall also have compulsory Industrial Training/ Mini Project for about 6 - 8 weeks, during the summer of 3\textsuperscript{rd} and final year project in 4\textsuperscript{th} Academic Year.

Project work should be a first experience for students of a Science & Tech project. It will require teams of 5 students working on projects proposed by labs, faculty or any scientific/technical stakeholders such as companies. Projects can deal with computing and simulation, small models, technical system study, extensive synthesis of a bibliography, test of concept or any need from a lab, a faculty member or a company.

At the end of the year a report and a defense will take place in front of a jury for evaluation.

SE204, in year 3, should be together a yearlong project provided by a company and, again, teams of 5 will work on a real need of such a client. Projects can be linked to a specific challenge and can be proposed by labs, faculty or any scientific/technical stakeholders such as companies.

Students will have inputs during the year regarding their professional skills. They will work mostly in autonomy but controlled by regular project reviews. At the end of the year a report and a defense will take place in front of a jury for evaluation.

3) Course Work:

3.1 The student after securing admission must pursue the 4 Year B.Tech. program of study for a duration of 8 semesters (or 4 years). Each semesters shall be of 22 weeks duration (inclusive of examination), with 17 weeks of instructions days.

3.2 The student should complete the 4 Year B.Tech. within a period of equal to twice the prescribed duration of the program, from the date of admission. Students, who fail to meet all the academic requirements for the award of the degrees within 8 academic years from the date of admission, shall forfeit their seat in B.Tech. courses.

4) Attendance Requirement:

4.1 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 in a semester.
4.2 Condonation of shortage of Attendance in aggregate up to 10% (Net Attendance of 65% and above, and below 75%) in each Semester maybe 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.

4.3 Shortage of Attendance below 65% in aggregate could be condoned on a case by case basis at the discretion of the Director, MEC.

4.4 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.

4.5 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 Readmission for that semester, as and when offered.

5) Academic Requirements:

Student may be terminated by MEC management if he/she is on Academic Probation and fails to secure a minimum Semester Performance Index (SPI) as under:

<table>
<thead>
<tr>
<th>UG</th>
<th>Minimum SPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>B.Tech.</td>
<td>4.5</td>
</tr>
</tbody>
</table>

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

5.1 a) Grades and Grade Points - At the end of the semester/summer term, a student is awarded a letter grade in each of his/her courses by the concerned Instructor-in-Charge taking into account his/her performance in the various examinations, quizzes, assignments, laboratory work (if any), etc., besides regularity of attendance in classes. The grades are submitted in the undergraduate office within the prescribed time limit of 72 hours after the end semester examination.

Each discipline shall evolve a procedure for the award of letter grades in project courses.

There are eight letter grades: A, B+, B, C+, C, D, E and F. The letter grades and their numerical equivalents on a 10-point scale (called Grade Points) are as follows:

<table>
<thead>
<tr>
<th>Letter Grades: A</th>
<th>B+</th>
<th>B</th>
<th>C+</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade Points:</td>
<td>10</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

In addition, there is an additional letter grade, viz., ‘I’ which stands for Incomplete.
b) Incomplete Grade ‘I’ - A student may be awarded the grade ‘I’ (Incomplete) in a course if he/she has missed, for a genuine reason, a minor part of the course requirement but has done satisfactorily in all other parts. An ‘I’ grade is not awarded simply because a student has failed to appear in examination(s). An ‘I’ grade must, however, be converted by the Instructor-in Charge into an appropriate letter grade and communicated to the undergraduate office by the last date specified in the academic calendar. Any outstanding ‘I’ grade after this date shall be automatically converted into the ‘F’ grade.

c) Project Grades – Project grades shall be submitted by the last date specified for the submission of grades. An ‘I’ grade will not be given for mere non completion of project due to lack of facilities, etc. An ‘I’ grade may be given only on medical grounds.

d) Change of Grade Already Awarded - A letter grade once awarded shall not be changed unless the request made by either the Instructor-in-Charge or another Instructor/tutor of the course is approved by the Chairman, Senate.

Any such request for change of grade must, however, be made within six weeks of the start of the next semester in the prescribed form with all relevant records and justification.

e) Semester Performance Index (SPI) – The Semester Performance Index (SPI) is a weighted average of the grade points earned by a student in all the courses credited and describes his/her academic performance in a semester. If the grade points associated with the letter grades awarded to a student are $g_1, g_2, g_3, g_4, \text{ and } g_5$ in five courses and the corresponding credits are $c_1, c_2, c_3, c_4, \text{ and } c_5$, the SPI is given by

$$\text{SPI} = \frac{c_1g_1+c_2g_2+c_3g_3+c_4g_4+c_5g_5}{c_1+c_2+c_3+c_4+c_5}$$

f) Cumulative Performance Index (CPI) - The Cumulative Performance Index (CPI) indicates the overall academic performance of a student in all the courses registered up to and including the latest completed semester/summer term. It is computed in the same manner as the SPI, considering all the courses (say, $n$), and is given by whenever a student is permitted to repeat or substitute a course, the new letter grade replaces the old letter grade in the computation of the CPI, but, both the grades appear on his/her Grade Report.

g) Grade Report - A copy of the Grade Report is issued to each student at the end of the semester. A duplicate copy, if required, can be obtained on payment of the prescribed fee.
5.2 Award of Degree or Class:
A student is required to complete successfully all the courses of the curriculum prescribed for his/her undergraduate program and attain a minimum level of academic performance, i.e., obtain a minimum CPI as under:

<table>
<thead>
<tr>
<th>UG</th>
<th>Minimum CPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>B.Tech.</td>
<td>5.0</td>
</tr>
</tbody>
</table>

In B.Tech., thesis work also has to be completed satisfactorily as per the procedures and rules stated in the Undergraduate manual.

5.3 Warning

A student is placed on Warning if his/her SPI and CPI at the end of a regular semester are as follows:

B.Tech.

a) SPI <= 4.5 and CPI >=5.0  
   Or
b) SPI > 4.5 and CPI <5.0

Such a student is required to sign an undertaking incorporating the following terms and conditions:

i) He/She shall register for all courses (if available) in which the letter grade F is obtained,
ii) He/She may register up to 22 credits, or a lower limit set by the department and approved by the MEC.
iii) He/She shall not hold any official position or represent the Institute in any extra-curricular activity during Warning.
iv) Any other term/condition laid down by MEC.

5.4 Academic Probation

A student is put on academic probation if his/her SPI and/or CPI at the end of a regular semester are as follows:

B.Tech.

SPI <= 4.5 and CPI <5.0
Such a student is required to sign an undertaking incorporating the following terms and conditions:

i) His/Her academic load shall be reduced. The student can register for a maximum of 17 credits, or a lower limit as set by the department and approved by MEC.

ii) He/She shall register for all courses (if available) in which the letter grade F is obtained.

iii) He/She shall obtain a minimum SPI of 4.5 or 5.5 if belonging to B.Tech.

iv) He/She shall not hold any official position or represent the Institute in any extra-curricular activity during Academic Probation.

v) Any other terms/conditions laid down by Senate.

vi) He/She shall automatically leave the Institute if fails to fulfill any of the above conditions.

5.5 Termination of Programme

The programme of a student may be terminated by MEC if he/she

a) Is on Academic Probation and fails to secure a minimum SPI as under:

<table>
<thead>
<tr>
<th>PROGRAMME</th>
<th>MINIMUM SPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>B.Tech.</td>
<td>4.5</td>
</tr>
</tbody>
</table>

b) Is absent without authorized leave of absence for a major part of the semester and does not appear in the end-semester examination of the courses in which he/she is registered.

c) Fails to report and register by the last date of registration without any bonafide reason.

d) Involves himself/herself, in violation of the code of conduct, in ragging, etc.

5.6  (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 to credits in any year, he may be readmitted into the next year after fulfilment of the academic requirements, with the academic regulations of the batch into which he got readmitted.

5.7 A student shall register for all the 172 credits as specified in the Course Structure and put up the minimum attendance requirements in all semesters; an exemption of 8 credits is permitted for optional dropout at UG level except for the courses listed below:

1. All laboratories oriented

2. Industrial Mini Project
3. Seminar

4. Comprehensive Viva – Voce

5. Major Project

Marks obtained in all the specified 172 UG credits shall be considered for the calculation of percentage of marks for the B.Tech.

5.8 Students, who fail to earn the 164 UG Credits out of 172 UG Credits registered as indicated in the course structure, within 8 Academic years from the date of Admission, shall forfeit their seat in the program, and their admission.

6) Evaluation Procedure:

The evaluation of students in a course is a continuous process and is based on their performance in two mid-semester examinations, an end-semester examination, quizzes/short tests, tutorials, assignments, laboratory work, make-up examinations (if applicable), etc.

a) Schedule of Examinations:

The schedule for the two mid-semester examinations, the end-semester examination and the make-up examination (if any) in core courses is prepared and announced by the Dean of Academic Affairs, whereas the schedule for these examinations in professional courses is prepared and by the respective Deans. All the examinations are usually held during the periods/days specified in the Academic Calendar.

b) Make-up Examinations:

If a student, for bonafide reasons such as illness, etc., fails to appear in the end-semester examination in one or more course(s), he/she may make a request personally for a make-up examination within two days of the date of the scheduled examination. Such a request must, however, be made on a prescribed form available in the Undergraduate Office, giving reasons for the failure to appear in the end-semester examination with a certificate from a Medical Officer of the Institute Health Centre, in case the failure was due to illness. Only one make-up examination, for the end-semester examination, is allowed per course. For failures to appear in mid-semester examinations, etc., it is entirely up to the Instructor to ascertain the proficiency of the student by whatever means he/she considers appropriate if he/she is satisfied of the student’s bonafidés.
7) **Withholding of Results**:

The grades of a student may be withheld if he/she has not paid his/her dues, or if there is a case of indiscipline pending against him/her, or for any other reason.

8) **Transitory Regulations**:

Students who have been detained for want of attendance, or who have failed, may be considered eligible for readmission to the same or equivalent subjects as and when they are offered, subject to Item 6.8.

9) **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 the rolls, as specified by the University/College.
- Wherever the word ‘he’ or ‘him’ 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 doubt in the interpretations of the above regulations, the decision of the Director will be final.
- The student shall be provided an opportunity to change his/her specialization during the first two years of study period based on their academic performance and review of the MEC management.
<table>
<thead>
<tr>
<th>Code</th>
<th>Course</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MA101 Math I: Calculus &amp; Ordinary Differential Equations</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>PH101 Physics I: Mechanics &amp; Thermodynamics</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>EE 101 Introduction to Electrical Engineering</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3.5</td>
</tr>
<tr>
<td>4</td>
<td>ME 101 Introduction to Engineering Design</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>SE 101 Introduction to Society &amp; Technology</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1.5</td>
</tr>
<tr>
<td>6</td>
<td>HS 101 Literature &amp; Philosophy</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>HS 102 French Language &amp; Culture</td>
<td>0</td>
<td>2</td>
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</table>

**Semester 2**

<table>
<thead>
<tr>
<th>Code</th>
<th>Course</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MA 102 Math II - Linear Algebra &amp; Applied Analysis</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>CB 101 Chemistry</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>EE 102 Electronics</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3.5</td>
</tr>
<tr>
<td>4</td>
<td>CS 101 Introduction to Computer Sciences</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>SE 102 Media Project</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1.5</td>
</tr>
<tr>
<td>6</td>
<td>HS 103 Cinema &amp; Philosophy</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>HS 104 French Language &amp; Culture</td>
<td>0</td>
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</table>

**Semester 3**

<table>
<thead>
<tr>
<th>Code</th>
<th>Course</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MA 203 Math III – Real Analysis &amp; Algebra</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>PH 202 Physics II: Electromagnetism &amp; Optics</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>ME 202 Solid Mechanics &amp; Fluid Mechanics</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>EE 203 Signals &amp; Systems</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>SE 203 Design Thinking</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>SE 205 Introduction to Enterprises &amp; Economy</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1.5</td>
</tr>
<tr>
<td>7</td>
<td>HS 205 Indian English Literature</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1.5</td>
</tr>
<tr>
<td>8</td>
<td>HS 206 French Language &amp; Culture</td>
<td>0</td>
<td>2</td>
<td>0</td>
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</tbody>
</table>
### Semester 4

<table>
<thead>
<tr>
<th>Code</th>
<th>Course</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MA 204 Math IV - Computational Methods &amp; Discrete Mathematics</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>CB 202 Biology</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>PH 203 Physics III: Introduction to Modern Physics</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>2.5</td>
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<tr>
<td>4</td>
<td>ME 203 Material Sciences</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>CS 202 Data Structures and Algorithms</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>ME 204 Manufacturing Engineering</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>SE 204 Design Project</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>HS 207 Modern Culture &amp; Philosophy</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1.5</td>
</tr>
<tr>
<td>9</td>
<td>HS 208 French Language &amp; Culture</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
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<tr>
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**Enterprise Sciences & Management**

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Course No: PH 101
Course Name: Physics I (Lab + Theory)
Credits: 6 (4-2-2)
Course Position: Semester 1 (Aug. to Dec.)

THEORY

Objectives:

Mechanics: The objective of this course is to present the basic definitions and theorems of kinematics and dynamics and their application to systems of particles. The course will cover: coordinate systems, kinematics in Galilean and non-Galilean reference frames, Newton's laws, friction, conservative forces, work-energy theorem, angular momentum, central forces, gravitation, Keplerian motion, dynamics of rigid bodies, oscillators, waves.

Thermodynamics: The objective is to present the basic definitions and theorems of thermodynamics useful for the understanding of the behaviour of condensed fluids and for CB102.

The course requires knowledge of basic mathematics (differential and integral calculus, vector analysis). Many of the theoretical concepts presented in the course will be reviewed and applied in the experimental PH101 labs, offered in the first semester.

Course Content:

Syllabus for Classical Mechanics

- Vectors and Kinematics
- Frame of reference and Coordinate Systems – Cartesian and Polar
- Newton Laws
- Friction
- Momentum
- Work & Energy
- Conservative and Non-conservative forces
- Angular momentum
- Dynamics of rigid body rotation
- Inertial (Galilean) and non-inertial frames of reference
- Central Force Motion
- Gravitation and planetary motion, Kepler’s laws
- The harmonic oscillator

**Syllabus for Thermodynamics**

- Temperature and zeroth law of thermodynamics
- Equation of state
- Hydrostatic systems
- Intensive and extensive coordinates
- Work
- PV diagram and $\int P\,dV$ for quasi-static processes
- Heat and first law of thermodynamics – Internal energy, Heat energy, Thermal conductivity
- The second and third laws of thermodynamics – Reversibility, Entropy, Absolute temperature

**Text Book:**

- An Introduction to Mechanics (Special Indian Edition, 2009) by Daniel Kleppner and Robert Kolenkow
- Heat and Thermodynamics (8th edition) by Mark W Zemansky and Richard H Dittman

**References:**

- Berkeley Physics Mechanics Vol. 1 by Charles Kittel, Walter D. Knight, Malvin A. Ruderman
- Berkeley Physics Fundamentals of Statistical and Thermal Physics. Vol. V by Frederick Reif
- Physics for Scientists and Engineers, Fishbane, Gasiorowicz, Thornton, Prentice Hall
LABORATORY WORK

Objectives:

The objective of the course is to let the students understand practically what basic laws and their effects are. They will practice mechanical, thermodynamical, optical and electromagnetical experiments and will be able to develop their intuitive understanding of natural effects. In parallel with the theoretical lectures they will face reality and will be in position to make links with its mathematical expressions.

Course Content:

Mechanics & Thermodynamics (Semester 1)

1- Maxwell’s wheel: free fall, inertia momentum
2- Pendulum: Eigen frequency of an oscillator, momentum, gravity force
3- Collisions of projectiles: 1D motion, elastic and inelastic collisions
4- Vibrating string: standing waves, eigenmodes, influence of boundary conditions
5- Acoustic Doppler effect: analogic mixing of electric signal to detect a change in the frequency
6- Calorimetry: heat capacity of water and several solids, Joule heating, latent heat of fusion, Dulong and Petit law.
7- Law of perfect gas, and absolute zero temperature
8- Measure of the gamma constant of the air: adiabatic processes, Clément-Désormes and Rüchhardt's methods.

Text Book:

Lab sheets.
Course No: MA 101
Course Name: Mathematics I
Credits: 5(4-2-0)
Course Position: Semester 1

Objectives:
The objectives of this course are to revise basic knowledge in Analysis and to define precisely the elementary tools for one variable function Calculus. All results and theorems will be proved carefully. Examples will be taken from appropriate engineering applications and related courses in engineering and physics EE 101, PH101.

Course Content:

Part 1

- Real number: ordered field, upper bound theorem; complex numbers: field, argument, modulus.
- Sequences, induction, limit, Cauchy sequences, theorems on limits, convergence velocity.
- Functions of one real variable: limit, continuity, comparison, theorems on continuity, intermediate value theorem, monotony, convexity...
- Elementary functions: exponential, logarithm; sine, cosine...

Part 2

- Differential calculus for one real variable function: derivative, structure theorems on derivatives.
- “Rolle’s theorem”, Taylor’s theorem, Estimate of the remainder.
- Integral calculus: definition, properties, Mean Value theorem, primitive, Fundamental Theorem.
- Differential Equations: general first order and linear second order equation, classical equations.
- Approximation by polynomials, fixed point and Newton methods for one real variable equation.

Part 3

- Integral of a continuous vector function of one real variable.
- Smooth parametric curve and surface. Tangent line and plane, Local study of a parametric curve, Length, Frenet frame, curvature.

Text Book:

- BARTLE and SHERBERT: Introduction to Real Analysis.

References:

- Walter RUDIN, Real and Complex Analysis, Walter RUDIN, Mc Graw-Hill
Course No: EE 101

Course Name: Introduction to Electrical Engineering

Credits: 3.5 (2-1-2)

Course Position: Semester 1

Objectives: The objective of this course is to learn basics of electricity, electrical circuits and essential functions in electronics.

On completion of the course, students should be able to

- Analyze electrical circuits in DC or AC mode.
- Realize an electrical circuit and perform measurements
- Use a spice software

Course Content:

Module 1: Lumped models of Electric network elements R,L,C and M from electromagnetic theory. Incidence matrix, circuit matrix, and derivation of Kirchoff's laws based on graph theory. Sources and their characteristics, network analysis using KCL, KVL and V-I relationships in differential form. Concept of Steady state and transient response, Sinusoidal excitations, importance of sinusoid, response to sinusoids, frequency dependency. Power and energy relations of network elements in time domain for sinusoidal excitations, average power and average stored energies. Complex representation of sinusoids, phasors, network analysis in terms of phasors, impedance concept, power relations in terms of phasors, complex power-real and reactive power. Passivity, generalization to complex exponential excitations in s plane


Module 3: One port and two port networks, Tellegen's theorem revisited, Impedance in terms average power and average stored energies, lossless networks. Two port parameters, Reciprocity.

Module 4: Purely inductive circuits, self and mutual inductance, ideal transformer, practical transformer, two port representation, simplified design and construction, effect of magnetic core, losses in transformer, transformer testing.
Module 5: Single phase and multiphase systems, importance of multiphase, star delta connection, balanced and unbalanced three phase systems

Module 6: Power transmission and distribution, Fundamentals of electromechanical energy conversion, DC Machines, AC Machines, Control systems

Text Book:

- Ralph Smith, Richard Dorf, Circuits, Devices and Systems (2007), Wiley (Student)
- Lessons In Electric Circuits, Tony R. Kuphaldt
  http://openbookproject.net/electricCircuits/

References:

- Fundamentals of electrical engineering / Giorgio Rizzoni, 2008
- The electric power engineering handbook / Leonard L. Grigsby, 2012
- Electric machinery / Stephan Umans, 2013
- Schaum's outline of basic electricity / Milton Gussow, 2009
- Schaum's outline basic electrical engineering / JJ Cathey, 1996
- Basic electricity : complete course / Van Valkenbrgh, Nooger, Neville, 1993

LABORATORY WORK

Objective:

Basic Electrical Engineering Laboratory

Familiarisation of Test and Measuring Instruments in the Lab, Study of R L and C- v-i relations, power dissipation measurement. Introduction to PSpice. Two element kind networks- transient and steady state response, Thevinin and Norton models, Differentiation and Integration. Three element networks- series and parallel RLC- Impedance vs frequency, resonance, phasor diagram. Design and verification of tuned circuit for given resonant frequency Q and bandwidth measurement. Q measurement and study of its variation with frequency, Effect of R on critical frequencies, their relationship, Power measurement- real power and imaginary power measurement, power factor, Mutual inductance and Transformer Measurement of two port v-i relations at single frequency and derivation of equivalent circuit. Calculation of coupling coefficient. Frequency response of transformer, large signal response of transformer.
Course No: ME 101

Course Name: Engineering Design

Credits: 3 (2-0-2)

Course Position: Semester 1

Course Content:


*Introduction to Design*: Need recognition and the conception of an idea to meet this need. Problem definition, and a method of directed development leading to the construction and evaluation of a prototype. Steps will include feasibility study, preliminary design, detailed design, design evaluation and optimization, and physical realizability. The method is quite general and can be applied in any synthetic design process.

A laboratory component of this course will require the student to design and build a prototype to solve some engineering problem or to prove out an idea.

**Text Book:**


**References:**

- Total Design by Stuart Pugh, Prentice Hall, 1990
- Effective Innovation: The Development of Winning Technologies by Don Clausing and Victor Fey, American Society of Mechanical Engineers, 2004

**LABORATORY WORK:**

Design and build a prototype which solves some engineering problem or prove out an idea.
Course No: SE 101
Course Name: Society & Technology
Credits: 1.5 (1-1-0)
Course Position: Semester 1

Objectives:

- Understand the Society challenges of the XXIst Century
- Introduce you to the multiple ways in which science and technology, individuals and institutions mutually shape one another to the benefit and sometimes detriment of society:
- Develop students' abilities to adopt a “critical” approach to science and engineering. What is the purpose of science? How should technology be used? What are the risks and benefits of science and technology? How are they distributed now? In the future?
- Apprehend social and human responsibility of Engineers. What responsibilities do scientists and engineers have for the knowledge and artifacts they create? What responsibilities do they have as members of a professional community? What about public accountability?
- Work on a team-project

On completion of the course, students should be able to

Understand the important Society challenges especially related to technological development.

Course Content:

- General conferences on Society, Science, Technology and Development. Examples:
- Philosophy of science: What is science? Does scientific knowledge necessarily mean progress?
- History of Science: from Babylonian science to the Industrial Revolution.
- The social impacts of technology 1: GMO
- The social impacts of technology 2: nuclear energy
- Technological risks and society: understanding and managing new technologies and their risks
- Technological innovation and the environment: Can technology save the Earth?

Text Book: Under the coordination of the referee, the lectures will be prepared and given by actors of civil society and/or corporate world and/or academic professors.
Course No: HS 101

Course Name: Introduction to Literature and Philosophy

Credits: 2 (1-2-0)

Course Position: Semester 1

Content:

Part I

Language Skills:

A. Writing Skills
   1. Elements of writing
   2. Purposes of writing
   3. Writing Practice

B. Introduction to Phonetics
   1. Vowels
   2. Consonants and plural markers
   3. Present and past tense markers

C. Introduction to Media, Communication and presentation skills

Part II

Introduction to Literature:

1. A Poem: “A thing of Beauty is a Joy Forever” from John Keats’ Endymion
2. A Soliloquy: “To be or not to be” from Shakespeare’s Hamlet
3. A Novella: “Animal Farm” by George Orwell
4. A One-Act Play “In the Zone” by Eugene O Neill

Part III

Introduction to Philosophy:

1. Philosophical Harbingers: Socrates and Plato
2. Critical Reasoning in the Socratic Dialogue
3. Immanuel Kant: “What is Enlightenment?”
4. Indian Perspective: Rabindranath Tagore’s “Unending Love”
Objective:

Part I

Language Skills:

Introducing the students to the understanding of the different elements and purposes of writing which will enhance their writing skills.

The exposure to the phonetic sounds will enable the students to learn the right pronunciation which will build confidence in their speech.

An understanding of how communication differs in academics and media.

Part II

Introduction to Literature:

The inclusion of Literature heightens the enthusiasm of the student as different genres are prescribed to make learning interesting. Under the mask of different genres students tend to read, understand, analyse and develop skills of critical appreciation. An enlightened mind can think in the right perspective. Thus we help the student to become a better communicator, writer and thinker.

Part III

Introduction to Philosophy:

An attempt to introduce the students to the Greek Masters of philosophy and the movement called Enlightenment. A quick look at other cultures and writers’ experiences will benefit the student intellectually.

An introduction to Indian Philosophy is added to help students think from their native perspective and compare and contrast the larger philosophical context to which they would belong. This ends with a poem of Tagore entitled “Unending Love”.

Reference Books

- The Republic of Letters by Dena Goodman
- Philosophers on Education by Amelie Oksenberg Rorty
- Improve Your Writing by V N Arora and Lakshmi Chandra
- A Text Book of English Phonetics for Indian Students by T. Balasubramanian
- “Workshops in Pronunciation” by Adrian Underhill
- A Glossary of Literary Terms by M H Abrams
- English Literature: A Very Short Introduction by Jonathan Bate
- Basic Communication Skills for Technology by Andrea J. Rutherford
- Philosophy and Literature: An Introduction by Ole Martin Skilleas

Course No: CB 101
Course Name: Chemistry (Lab + Theory)

Credits: 6 (4-2-2)

Course Position: Semester 2

Objectives:

The objective of the course is to let the students understand basic chemistry and the relevance to modern day engineering. While basic concepts of chemistry will be introduced in the lectures, practical aspects pertaining to synthetic and analytical chemistry will be introduced in the laboratory and students will be able to develop their intuitive understanding of natural effects.

Course Content:

Lectures and tutorials

Chapter 1 Structure and bonding (15h)
  - Electronic Configurations, Atomic Properties and Periodic Table
  - Atomic orbitals
  - Chemical Bond (Lewis theory)
  - VSEPR Method
  - Molecular Orbitals (homonuclear diatomic molecules, LCOA)

Chapter 2 Kinetics (10h)
  - Rate Law and order of reactions
  - Determination of reaction rates
  - Effect of temperature
  - Theories of chemical kinetics
  - Introduction to Catalysis (air pollution, catalytic converter)

Chapter 3 Chemical Reaction in Aqueous Solution (10h)
  - Chemical equilibrium and displacement
  - Acido-basic equilibrium
  - Solubility / introduction to intermolecular forces
  - Water: Types of hardness, consequences and their remedies.

Chapter 4 Introduction to organic molecules (15h)
  - Electronic effect
  - Common functional groups
  - Stereochemistry (conformation & configuration)
  - Aliphatic functional group chemistry
  - Aromatic compounds
  - Natural products and biomolecules

Chapter 5: Polymer chemistry (10h)
  - Basic polymer chemistry (Molecular weight, degree of polymerization)
  - Types of polymerization (anionic, cationic, free radical, )
  - Crystallinity, Glass transition, viscoelasticity
  - Structure-property correlations.
Chapter 6 Instrumental methods of Chemical Analysis (15h)

- Introduction to H-NMR
- Spectro UV-Vis (Electronic levels, Beer Lambert law)
- Spectro IR (introduction to theory + spectral analysis)
- Mass spectrometry
- Chromatography: HPLC, GPC, GC.

Laboratory Work (any 10 experiments from the list below)

1) Determination of organic functional groups such as alcohol, acid, amine, nitro, ester, etc., through simple group tests.
2) Preparation and characterization of Aspirin
3) Separation of the components from a mixture of two or more organic compounds by column chromatography and thin layer chromatography
4) Preparation of poly dimethyl siloxane (PDMS) with different proportion of cross-linking agent
5) Analysis of percentage of copper and zinc in a sample of brass
6) Precipitation of calcium as calcium carbonate in different crystallographic forms under suitable experimental conditions its relevance to biomineralization
7) Synthesis of silver nanoparticles by reduction of AgNO₃ and the evaluation of the optical properties by spectrophotometry
8) Determination of total hardness of water by complexometric titration
9) Determination of Ca²⁺ in presence of Mg²⁺ using EDTA
10) Analysis of alkalinity of water (carbonate, bicarbonate, hydroxide) using titration method
11) Determination of surface tension of a liquid by drop count method and the effect of addition of various concentrations of an additive
12) Kinetics of hydrolysis of ester (or) decomposition of hydrogen peroxide
13) Equilibrium constant of KI + I₂ = I₃⁻ by partition method and solubility method
14) Conductometric titration of a) strong acid vs Strong base and b) Weak acid vs Strong base.
15) Preparation of phosphate, citrate, borate buffers and evaluating their pH resistance
16) Demonstration of the working of spectrophotometer UV-Vis and FT-IR, sample preparation techniques for spectrophotometers

Text Book:

- Physical Chemistry a short course W.E Wentworth ISBN: 0-632-04329-6
- Inorganic Chemistry by J. D. Lee
- Inorganic Chemistry by Huheey, Keiter, Keiter
References:

Objective:

- The objective of this course is to study basic linear algebra in the abstract setting of finite dimensional vector spaces and to apply the geometric point of view to matrix properties and linear systems. The course completes the introduction to Analysis (MA 101) with the study of mathematical tools for physics and elements of differential geometry. Examples will be taken from appropriate engineering applications and related courses in engineering and physics PH102.

Course Content:

Algebra:

Part 1: Real and complex vector space: subspace, spanning and linear dependence of subset, Finite dimension: basis, dimension, complementary subspace, direct sum. Matrix of a vector system, change of coordinates, Linear map: addition and composition; kernel and image, rank; one to one and, onto maps, matrix of a linear map.

Part 2: Matrix: addition and multiplication, singular matrix, determinant, rank, inverse, adjugate, Linear system: abstract study, Gaussian Elimination, Transpose and conjugate matrix; similar matrix, Eigenvalues and eigenvectors of a linear map. Characteristic polynomial of a matrix, diagonalizability.

Part 3: Inner product, Cauchy-Schwarz, Norm, triangle inequality. Euclidian spaces, Orthogonal and orthonormal family and basis, Gram-Schmidt orthonormalization, Symmetric and orthogonal matrices, diagonalization of a symmetric matrix.

Analysis:


Part 5: Vector field (N=2, 3): operator Div, Curl, Laplacian. Double and triple integrals.

Text Book:

- A O MORRIS: Linear Algebra- An introduction.
References:

S. LANG: Introduction to linear algebra, Springer
Objectives: The objective of this Course is to provide the students with an introductory and broad treatment of the field of Electronics Engineering.

Course Content:

Module 1: Diodes and Applications covering, Semiconductor Diode - Ideal versus Practical, Resistance Levels, Diode Equivalent Circuits, Load Line Analysis; Diode as a Switch, Diode as a Rectifier, Half Wave and Full Wave Rectifiers with and without Filters; Breakdown Mechanisms, Zener Diode – Operation and Applications; Opto-Electronic Devices – LEDs, Photo Diode and Applications; Silicon Controlled Rectifier (SCR) – Operation, Construction, Characteristics, Ratings, Applications;

Module 2: Transistor Characteristics covering, Bipolar Junction Transistor (BJT) – Construction, Operation, Amplifying Action, Common Base, Common Emitter and Common Collector Configurations, Operating Point, Voltage Divider Bias Configuration; Field Effect Transistor (FET) – Construction, Characteristics of Junction FET, Depletion and Enhancement type Metal Oxide Semiconductor (MOS) FETs, Introduction to CMOS circuits;

Module 3: Transistor Amplifiers and Oscillators covering, Classification, Small Signal Amplifiers – Basic Features, Common Emitter Amplifier, Coupling and Bypass Capacitors, Distortion, AC Equivalent Circuit; Feedback Amplifiers – Principle, Advantages of Negative Feedback, Topologies, Current Series and Voltage Series Feedback Amplifiers; Oscillators – Classification, RC Phase Shift, Wien Bridge, High Frequency LC and Non-Sinusoidal type Oscillators;

Module 4: Operational Amplifiers and Applications covering, Introduction to Op-Amp, Differential Amplifier Configurations, CMRR, PSRR, Slew Rate; Block Diagram, Pin Configuration of 741 Op-Amp, Characteristics of Ideal OpAmp, Concept of Virtual Ground; Op-Amp Applications - Inverting, Non-Inverting, Summing and Difference Amplifiers, Voltage Follower, Comparator, Differentiator, Integrator;

Module 5: Basic Digital Electronics covering, Binary Number Systems and Codes; Basic Logic Gates and Truth Tables, Boolean Algebra, De Morgan’s Theorems, Logic Circuits, Flip-Flops – SR, JK, D type, Clocked and Master-Slave Configurations; Counters – Asynchronous, Synchronous, Ripple, Non-Binary, BCD Decade types; Shift Registers – Right-Shift, Left-Shift, Serial-In-Serial-Out and Serial-In-Parallel-Out Shift Registers; Applications;

Text Book/References:

2. Santiram Kal (2002), Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India
3. David A. Bell (2008), Electronic Devices and Circuits, Oxford University Press
LABORATORY WORK

Course Content:

- Digital electronics lab: Digital logic simulation software (software dedicated to education, or if not Quartus Software Suite from Altera) enabling to edit and simulate schematics designs.
  - 7 segments decoder (truth table, equations, logic design, simulation)
- Analog electronics lab: education dedicated small systems for operational amplifiers, plus oscilloscope, low frequency signal generator, power source
  - Adder
  - Amplification
  - Filtering: Bode diagram, bandwidth)

Text Books:


LABORATORY WORK

Objective:

Course Content:

- Digital electronics lab: Digital logic simulation software (software dedicated to education, or if not Quartus Software Suite from Altera) enabling to edit and simulate schematics designs.
  - 7 segments decoder (truth table, equations, logic design, simulation)
- Analog electronics lab: education dedicated small systems for operational amplifiers, plus oscilloscope, low frequency signal generator, power source
  - Adder
  - Amplification
  - Filtering: Bode diagram, bandwidth)

Text Books:

Course No: CS 101  
Course Name: Introduction to Computer Science  
Credits: 3(2-0-2)  
Course Position: Semester 2

Objectives:  
This course is an introduction to programming language and methods.

Course Content:  
- Introduction to an interpreter programming language, with its basic constructions (variables, assignment, control primitives) and its main components (text editor and interpreter, or one EDI)
- Main data types (lists, stacks, files, trees, graphs) and associated algorithms (sorting, tree and graph traversals)
- Problem solving: design of algorithms, analysis of algorithms efficiency, general principles (divide-and-conquer)
- Introduction to testing and proof of algorithms.

Text Book:  
- Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein
- Python 3 Documentation, https://docs.python.org/3/

References:  
- Data Structures and Algorithms, Alfred V. Aho, Jeffrey D. Ullman, John E. Hopcroft
- Algorithms, Robert Sedgewick, Kevin Wayne
LABORATORY WORK
Objective:
• This course assumes the student is familiar with the basic structure of a computer and introduce the notions of an algorithm and a function.
• It also assumes familiarity with basic arithmetic operations, and introduces elementary control structure. The course introduces the following techniques for solving different problems by programming:
  o Design of (arguably correct) algorithms as solutions to problems
  o Use of abstraction and data organization for implementing algorithms
  o Analyzing the efficiency of algorithms.
• Python 3 will be used as a vehicle for demonstrating and practicing these techniques.

Course Content:
• Introduction to functions, IO and scripts
• Arrays and Strings – Data Abstraction
• Arrays – Matrices, Strings
• Correctness of algorithms – formal verification of algorithms
• Algorithm Design techniques – Sorting and searching
• Implementation of Non–Linear Data Structures – Tree, Graph

Text Books:
Course No: SE 102
Course Name: Media Project
Credits: 1.5 (1-1-0)
Course Position: Semester 2

Objectives:

- Understand the Society challenges of the XXIst Century
- Introduce you to the multiple ways in which science and technology, individuals and institutions mutually shape one another to the benefit and sometimes detriment of society:
- Develop students' abilities to adopt a “critical” approach to science and engineering. What is the purpose of science? How should technology be used? What are the risks and benefits of science and technology? How are they distributed now? In the future?
- Apprehend social and human responsibility of Engineers. What responsibilities do scientists and engineers have for the knowledge and artifacts they create? What responsibilities do they have as members of a professional community? What about public accountability?
- Work on a team-project

On completion of the course, students should be able to

Understand the important Society challenges especially related to technological development. Present a short 5-minute documentary film in the form of a group exercise. This project has to be done within a specific production period.

Course Content:

- General conferences on Society, Science, Technology and Development. Examples:
- Philosophy of science: What is science? Does scientific knowledge necessarily mean progress?
- History of Science: from Babylonian science to the Industrial Revolution.
- The social impacts of technology 1: GMO
- The social impacts of technology 2: nuclear energy
- Technological risks and society: understanding and managing new technologies and their risks
- Technological innovation and the environment: Can technology save the Earth?

Text Book:

Under the coordination of the referee, the lectures will be prepared and given by actors of civil society and/or corporate world and/or academic professors.
Course No: HS 103
Course Name: Cinema and Classical Philosophy
Credits: 2 (1-2-0)
Course Position: Semester 2

Objectives:

PART 1: CINEMA

• Introduce students to the bases of film analysis and cinema culture in intellectual spheres
• Familiarising students with the tools of reading cinematographic language
• Contribution of other Industrial developments on the cinematic apparatus
• How do the material realities of film production influence creative processes?
• Creation of an internal corpus illustrating concepts that are locally relevant and meaningful

PART 2: AN INTRODUCTION TO PHILOSOPHICAL THOUGHTS

• Introduce students to philosophical thought from the Enlightenment to Pragmatism
• Key areas of socio-political conflict in the 21st century which impacted Philosophical Thoughts
• Notions surrounding Diegesis and Verisimilitude through the Industrial period
• Studying the dialectical relationship between Realism and Formalism in visual language
• A basic study of key Cinema philosophers in this period

Course Content:

1. Critical Tools: How to Read a Movie
   • Photograph Analysis
   • Basic Film Criticism and Theory
   • Film Aesthetics
2. Using Cinema for Social Analysis
   • Scene by scene analyses
   • Identifying social themes with cinematic expressions
   • Attributing Meaning and Message through the Medium of Film

Textbook:

• Major Film Theories - Dudley Andrew

References:

• The Photoplay by Hugo Munsterberg
• Film Form and Film Sense by Sergei Eisenstein
• What is Cinema? Part 1 and 2 by Andre Bazin
• Film Art by Bordwell and Thompson
• Making Short Films by Clifford & Thurlow
• Video Production by Vasuki Belvadi
• A bibliographical Dictionary of the cinema, David Thomson
• The Philosophy of the Enlightenment, Cassirer, E, Princeton University Press, 1979
**Course No:** PH 202  
**Course Name:** Physics II (Electromagnetism + Optics)  
**Credits:** 6 (4-2-2)  
**Course Position:** Semester 3  

**Objectives:**

The objective of this course is to present the basic definitions and phenomena in Electromagnetism and Optics.

**Course Content:**

**Electro- and Magneto-statics**


Biot & Savart’s law, Amperes law. Divergence and curl of magnetic field, Vector potential and concept of gauge. Calculation of vector potential for a finite straight conductor, infinite wire and for a uniform magnetic field Magnetism in matter, volume and surface currents, Field H, classification of magnetic materials Faraday’s law in integral and differential form, Motional EMF Displacement current.

**ELECTROMAGNETISM**

- Maxwell’s equations, Electromagnetic waves, wave equation, e.m. waves in vacuum and media, refractive index, Energy and momentum of e.m.w., Pointing vector, radiation pressure. Polarization of e.m. waves, Reflection and refraction, skin depth, standing electromagnetic waves, resonating cavity. Waveguides with rectangular metallic boundaries, TE, TM and TEM mode Electric dipole radiation.

**Optics**


Part 2: wave optics: Optic path of a beam of light, wave front and Malus theorem, Interference between two coherent waves, Frenel mirrors, slits and holes, Michelson interferometer, Huygens-Fresnel principle, scattering at infinity of a plane wave, limits of geometrical optics, Planar gratings.

**Text Book:**

- Introduction to Electrodynamics: D.J. Griffiths  
- Electricity and Magnetism: Mahajan and Rangwala  
- Electricity and Magnetism: Purcell (Berkeley Series)
 References:

- Electricity and Magnetism: Purcell (Berkeley Series)
- J.D.Jackson, G. B. Fowles, Introduction to Modern Optics, Dover, 1975

LABORATORY WORK

Objective:

The objective of the course is to let the students understand practically what basic laws and their effects are. They will practice optical and electromagntetical experiments and will be able to develop their intuitive understanding of natural effects. In parallel with the theoretical lectures they will face reality and will be in position to make links with its mathematical expressions.

Course Content:

- 1-2 Geometrical optics, lens, ...
- 3-4 Interference: Young’s slits & diffraction
- 4-5 Grating & Spectrometry
- 6-7 Electromagnetic waves
- 8: Measure of the magnetic field
- 9 Magnetic Induction

Text Books:

Lab sheets
Course No: MA 203

Course Name: Mathematics III (Real Analysis and Algebra)

Credits: 5 (4-2-0)

Course Position: Semester 3

Objectives:

Analysis: The course completes the introduction to Analysis (MA 101) with a deeper insight into the single variable function Calculus.

Algebra: The course completes MA102 to study finite dimensional vector spaces and to apply the geometric point of view to matrix and operator properties.

Examples will be taken from appropriate engineering applications and related courses in engineering and physics.

Course Content:

**Analysis:** Part 1: Finite dimensional vector space: norm, sequences, limit, Function of N real variables, limit, continuity, convexity, Differential, partial derivatives, chain rule, gradient, continuously differentiable maps, Jacobian matrix.


Part 3: Complex power series, *radius of convergence, real power series, Fourier series, definition, basic properties, (convergence: admitted).*

**Algebra:** Part 1: Linear operator on finite dimensional linear spaces over R or C, stable subspaces, Trignonalization of operators in vector spaces over the field C, Characterisation of diagonalizable operator, Application to linear recurrences and linear differential systems.


Text Book:


References

Serge LANG, Algebra, Springer
Course No: ME 202
Course Name: Solid Mechanics and Fluid Mechanics
Credits: 3 (2-2-0)
Course Position: Semester 3

Objectives:
This course aims at giving the basic models to understand the mechanics behaviour of simple structures and simple flows. It is then restricted to statics of elastic beams and frames and an introduction to fluid mechanics limited to hydro-statics, ideal fluids, stokes flows and acoustics waves.

Course Content:

Part 1: Statics of beams

- Kinematics of Timoshenko and Euler-Bernoulli straight uniform beams under small transformations, kinematic boundary conditions.
- Static of beams: Saint-Venant Principle, Moment, shear and normal forces equations, static boundary conditions.
- Iso-static systems, thrust frames.
- Linear elastic constitutive behaviour of beams.
- Hyper-static beams and frames.
- Shortcoming of the proposed model.

Part 2: Fluid mechanics

- Reynolds Transport Theorem; Integral form of continuity, momentum and energy, Eulerian and lagrangian view-points;
- Hydrostatics,
- Ideal frictionless fluids, Newtonian fluids, Stokes condition.
- Exact solutions; Potential flow;
- Constitutive relations; Introduction to Navier Stokes equations.

Part 3: Introduction to acoustics

Text Book:

- Introduction to Fluid Mechanics by R. W. Fox and A.T. McDonald (Wiley, 1992)
- Engineering Fluid Mechanics by K. L. Kumar, S.Chand & Co.
References:

- Fluid Mechanics, J. Spurk, N. Aksei, Springer
- Fundamentals of Structural Mechanics - Keith D. Hjelmstad
Course No: EE 203
Course Name: Signals and Systems
Credits: 3 (2-1-1)
Course Position: Semester 3

Objectives:
The objective of this course is to learn how to consider continuous signals and systems from a functional point of view. Time, spectral, complex representations, elements to characterize behavioural models are presented. These concepts are used in order to design a specified closed loop structure.

Course Content:

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<th>Lectures (hr)</th>
<th>Tutorials (hr)</th>
<th>Lab work</th>
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<td><strong>Introduction</strong></td>
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<tr>
<td>Signals and systems: two related concepts. Examples, modelling (organization, simplification, owing to objectives), classical signal processing structure</td>
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<tr>
<td><strong>Signal and system Time Representations</strong></td>
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<td><strong>Signal and system Spectral Representations</strong></td>
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<td><strong>Identification</strong></td>
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<tr>
<td>Transient and Harmonic analysis. Frequency response representation: Black, Nyquist, Bode diagrams. Time and spectral behavioural models of usual systems: step and frequency response of integrator, first and second order systems. Strejc’s identification</td>
<td></td>
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</tbody>
</table>
**Text Books:**


**References:**

- Schaum’s outline of signals and systems / Hwei Hsu, 2010
- Understanding digital signal processing / Richard G. Lyons, 2010
- Digital signal processing : fundamentals and applications / Li Tan, 2007
- Digital signal processing / John G. Proakis, 2006
- Signals and systems / Alan V. Oppenheim, 1996
- Analog and digital signal processing / Ashok Ambardar, 1999
- Signal processing systems : theory and design / N. Kalouptsidis, 1997

**LABORATORY WORK**


**Text Books:**

Course No:  SE 203
Course Name:  Design thinking
Credits:  2 (1-0-2)
Course Position:  Semester 3

Course Content:

Module 1: Elements of design: 2D Composition, Figure/Ground Relationships, Part/Whole relationships, Rhythm and repetition, Balance, Symmetry, Abstraction, Expression, Gestalt laws of visual perception, Visual Arts, Modernism in Painting, Space Handling, Problem Solving with random shapes, corners, edges, planar qualities, geometry

Module 2: Studies in FORM, 3D Composition, Mass, Flow, Bulk, Edge, Radii Manipulation, Abstraction Theory of Solids, Geometrical constructions, meaning in sculpture, 3D object creation, object expression, Handling tools, Problem Solving of a 3D shape corners, edges, planar qualities, geometry, completion systems

Module 3: People Studies: Ethnography, Design research Methods, Interaction Observations, Usability Methods, Participatory Methods


Module 5: Nature of Materials and Processes, Base building material properties – Code type, Plastics, Electronics, etc, Material Processes Material Estimates

Module 6: Product Planning/ positioning and marketing Market Analysis, Competitive Benchmarking Customer Feedback and retention techniques, Market Segmentation, Personas, Profiling techniques, Survey Methods, Quantitative methods in research

Teaching materials and Text Books:

- http://sel.fas.harvard.edu/
- http://hbr.org/2009/03/ethnographic-research-a-key-to-strategy/ar/1
- http://ethnographymatters.net/

References:

Course No: SE 205
Course Name: Introduction to Enterprise and Economy
Credits: 1.5 (1-1-0)
Course Position: Semester 3

Objectives:

The course provides students with a structured understanding of how companies operate and can be managed. After the class, students should be familiar with concepts such as governance, strategy, partnering, organizing, etc.

Course Content:

- Introduction: objectives, stakeholders, operations and product life cycles
- Marketing of products and services
- Corporate strategy
- Growth process and strategic plan
- Structure and processes, informal organization
- Performance driving and operations management
- Management of innovation and technology

Text Books: Course reader in English + copy of the slides presented in class

References:

- The structuring of organizations, H. Mintzberg
- Principles of economy, N. Gregory Mankiw
- Economics, Organization and Management, Paul Milgrom and John Roberts
Course No: HS 205
Course Name: Indian English Literature
Credits: 1.5(1-1-0)
Course Position: Semester 3

Objectives:
Introduce the students to understand his or her own society in the light of the native authors, expatriate authors and the foreign authors. This will throw light on the fact that the student needs to accept different perspectives of his own country thus enabling him to have a holistic understanding of and acceptability of other cultures.

Using literature as a means to Understanding and interpreting the Indian society Understanding, interpreting and using literary texts including novels, essays and poetry

Course Content:
Study of a common theme from different viewpoints: local native writers (R. K. Narayan, Vikram Seth et al.); foreign writers of Indian origin (S. Rushdie, Anita Desai et al.); foreign writers (Kipling, Forster et al.); from different periods and using different types of literary texts

Text Books:
- *The Guide* a novel by R.K Narayan or A poem *All You Who Sleep by Night* by Vikram Seth
- A novel with Magic Realism *Midnight's Children* by Salman Rushdie or A novel *Journey to Itaca* by Anitha Desai
- A poem *A tale of Two Cities* by Rudyard Kipling or A novel *A Passage to India* by E M Forster.

Students will also be introduced to the phonetics labs and will be indulged in pronunciation practice.

References:
- T Brennan, Salman Rushdie and the Third World
- K S Ramamurti, Rise of the Indian Novel in English

Testing:
Students will be tested at the end of the semester through a written examination. They will also be taught how to do a presentation and they can choose one of the novels and present, while the same can be also submitted as a project. The marks allocation could be 70:30 (70% for semester end exam and 15% for Oral Presentation and 15% for dissertation submission)
Course No: CB 202
Course Name: Biology (Introduction to Bio Chemistry and Cell Biology)
Credits: 2 (2-0-0)
Course Position: Semester 4

Objectives:
This course is an introduction to biochemistry and cell biology. It will provide the concepts necessary to understand biotechnological applications (and xxx) presented at semester xx.

Course Content:

Chemical components of the cell (17h)
Presentation of bio-molecules: From amino acids to proteins (focus on physicochemical principles behind the common techniques for protein purification and characterization), Lipids and membrane, Sugars and polysaccharides, Nucleic acid structure and properties

Labs (3h): 3D visualization and manipulation of DNA molecules or proteins with free visualization softwares as VMD (http://www.ks.uiuc.edu/Research/vmd/), Enzymes (presentations, rates and enzymatic catalysis). Expression and transmission of genetics information (transcription & translation)

Introduction to the cell (20h)

- Prokaryotes & eukaryotes
- Internal Organization of the Cell
- Presentation of cellular compartments
- How cells are studied? (Looking at the structure of cells in the microscope, isolating and growing cells, analysis of their molecules, taking molecules inside cells)
- Energy Conversion: Mitochondria (and Chloroplasts if the trimming is compatible)

Elective PROGRAM:

Other cellular function could be also presented

- Cytoskeleton
- Membrane transport and ionic basis of membrane excitability
- Traffic in the secretory pathways

Text Book:

- Lehninger Principles of Biochemistry (Freeman Ed.)+ Website OR Voet Biochemistry (Wiley Ed.)

References:

- Alberts Molecular Biology of the cell (Garland Ed.)
Course No: PH 203

Course Name: Physics III: Introduction to Modern Physics

Credits: 2.5 (2-1-0)

Course Position: Semester 4

Objectives:
This course aims at reviewing and deepening Newtonian and Maxwellian physics concepts to identify their range of validity and the main limitations that initiate the rise of modern physics in the XX Century. It will also bring some advanced concepts, in particular, the Lagrangian and Hamiltonian formalisms which will be used in when studying quantum and statistical Physics in PH306.

Course Content:

- Special relativity
- Relativistic invariance of Maxwell’s equation
- Radiation pattern and diffusion
- Equilibrium emission of black bodies
- Radio-activity
- Dynamical systems, Lagrangian and Hamiltonian formalisms.

Text Book and References:

- Arthur Beiser: Concepts of Modern Physics
- NEIL ASHBY, STANLEY C. MILLER: Principles of Modern Physics
- Ajoy Ghatak: Basic Quantum Mechanics (Macmillan)
- Goldstein: Classical Mechanics
Course No: MA 204
Course Name: Mathematics IV (Computational Methods + Discrete Mathematics)
Credits: 5 (3-2-2)
Course Position: Semester 4

Objectives:
The course presents numerical tolls for engineering computations and the mathematical theories useful to understand the algorithms. The course uses many previous mathematical notions studied previously for error study. Examples will be taken from appropriate engineering applications and related courses in engineering and physics.

Course Content:

Part 1:
• Notion of floating point computation error.
• Linear system: LU factorization and elimination methods
• Real and vector recurrence. Matrix iteration
• Interpolation methods: Lagrange, orthogonal polynomial. Curve fitting, least square.

Part 2:
• Error estimation for approximation method.
• Nonlinear equation, algebraic equation, fixed point and Newton methods.
• Approximated integral: trapezoidal rule, Simpson’s rule. Accuracy: assessment.
• Differential equations: Euler and trapezoidal schemes. Accuracy: assessment.

Part 3:
• Nonlinear system: fixed point and Newton methods.
• Optimization of convex functions: gradient and relaxation method.
• Lagrange multipliers.

Part 4: Discrete Mathematics
• Sets, countable/uncountable sets, integers, induction.
• Functions, relations, equivalence classes, partitions, elementary graph theory.
• Propositional logic, Boolean algebra.
• Combinatorics – Counting principles, recurrence equations, generating functions.

Text Books:
• A Logical Approach to Discrete Math (Monographs in Computer Science) David Gries, Fred B. Schneider
Reference Books:

  Equations of Mathematical Physics, by V. S. Vladimirov, Alan Jeffrey.
Course No: ME 203

Course Name: Material Science

Credits: 3(2-1-1)

Course Position: Semester 4

Objectives:

- To discover the main classes of materials (ceramics, metals, polymers, composites...) and their properties
- To understand the physical origin of the mechanical and functional properties
- To have the bases for material selection for a given purpose

Course Content:

Main classes of materials:

* Atomic bonding and crystallography to get the main properties of materials (14 space lattices, unit cells, cubic and HCP structures, Miller indices, Packing, interstitials, different ceramic structures; Non-crystalline/nanocrystalline materials-definitions, concept of Tg, local order, different polymer structures)
* Microstructure characterization (e.g. X-ray diffraction (Bragg’s diffraction and structure factor for cubic lattices), TEM and SEM...)
* Origin and role of defects (point defects, edge and screw dislocations-their notation and concepts, energy of a dislocation, stacking fault, grains and grain boundaries, bulk defects)

- Thermo-equilibrium and kinetics:

  * Equilibrium and phase diagrams (definition of a phase, phase rule, unary and binary (eutectic, eutectic with terminal solid solutions) systems and examples, phase diagrams of important metal and ceramic systems)
  * Diffusion (definition of diffusivity, concept of activation energy, examples of diffusion process)
  * Precipitation and phase transformation (nucleation and growth (homogeneous and heterogeneous), Introduction to TTT curves, examples of various transformations)

- Mechanical properties:

  * Macroscopic behaviour (measures of mechanical response (fundamental measurable mechanical properties), engineering and true stress-true strain response, concept of yield point and Elastic modulus (composite materials) viscoelasticity, fracture toughness, stress intensity factor, fracture energy, comparison of these properties for different engineering materials)
* physics of deformation (deformation of single and polycrystalline materials, slip systems, critical resolved shear stress, mechanisms of slip and twinning)

* strengthening mechanisms and rupture (fracture in ductile and brittle (Griffith’s Theory) solids, ductile to brittle transition)

* fatigue and creep properties

**Overview of functional properties:**

* Thermal properties (heat conduction, dilatation...)

* Electrical conduction (band theory of solids, existence of metals and insulators, semiconductors, ferroelectricity and piezoelectricity...)

* Magnetic properties (dia-, para-ferro- and ferri magnetism, soft/hard magnetic materials...)

* Optical properties

**Text Book:**

- W.D. Callister, Materials Science and Engineering,

**References**

- M.F. Ashby and D.R.H. Jones, Engineering Materials 1: An Introduction to Their Properties and Applications,

**LABORATORY WORK**

This course introduces fundamental physical principles governing the structure, processing, properties and performance of metallic, ceramic and polymeric materials. Relationships are developed defining how mechanical, physical and chemical properties are controlled by microstructure and chemistry. Following experiments will be performed as a part of the course. The experiments are designed in such a way that, the student can appreciate the differences present in various classes of materials.

**Experiment 1.** Determination of metallurgical microstructure of a given sample and measure grain size.

- *This requires polishing of the samples on a series of SiC papers followed by Alumina powder and then etching with suitable chemical reagent.*

**Experiment 2.** Vickers hardness measurement of metals, concrete, ceramics and polymer sample.

- The student has to obtain a mirror polished surface and then have to measure the hardness of various sample.
Experiment 3. Heat treatment of a given steel and obtained various grain sizes and determine the ASTM grain size by standard measurement.

Experiment 4. Determination of glass transition of a given polymers.

Experiment 5. Generate precipitation hardening curve for an Al-Cu alloy. (The diagram can be constructed based on the hardness measurement obtained from various groups.

Experiment 6. Determination of impact toughness of steel, concrete and annealed polymer. Study the effect of temperature, grain size and notch sensitivity on the toughness values.

Course No: CS 202
Course Name: Data Structures and Algorithms
Credits: 3 (2-0-2)
Course Position: Semester 4

Objectives:
This course is an introduction to Programming language and methods. The course is based on lectures, exercises and labs.

Course Content:
- PROGRAM structure: object oriented (OO) approach-classes including the notions of objects, methods, variables, state, inheritance, typing, static-dynamic binding, scope, encapsulation, visibility, ...
- Exception handling
- Input/output handling, files
- User Interface and model-view controller
- Dynamic Programming
- Some classical algorithmic problems (shortest path in a graph, sequence alignment, automata)
- Introduction to calculability issues (indecidability, complexity classes)
- Compilation, separate compilation

Text Book:
- Introduction to Algorithms, Thomas H. Cormen Charles E. Leiserson Ronald L. Rivest Clifford Stein
- Thinking in JAVA", Bruce Eckel
- "Effective JAVA", Joshua Bloch
- "Object Oriented Software Construction" Bertrand Meyer

References:
- Data Structures and Algorithms, Alfred V. Aho, Jeffrey D. Ullman, John E. Hopcroft
- Algorithms, Robert Sedgewick, Kevin Wayne

LABORATORY WORK

Objective:
- Students will learn to design software using abstract data and control structures. These structures will include lists, stacks, queues, trees, and hash tables.
- Students will learn to use recursion in PROGRAM construction.
- Students will learn to implement abstract data types in alternate ways.
- Students will learn to quantitatively evaluate alternative implementations and explain the trade-
offs involved.

**Course Content:**

- Singly Linked List
- Doubly Linked List
- Polynomial Addition
- Infix to Postfix Expression
- Binary Tree Traversal
- Circular Queue - Producer Consumer problem
- Binary Search Tree
- AVL Tree
- Queue using binary heaping
- Hashing Techniques
- Topological Sorting
- Dijkstra's Algorithm
- Prim’s Algorithm
- Backtracking Algorithm – Knapsack Problem
- Branch and Bound Algorithm- Travelling Salesman Problem
- Randomized Algorithm

**Text Books:**

- Data Abstraction and Problem Solving with Java
- Walls and Mirrors, 2nd edition.
- Frank M. Carrano, Janet J. Prichard
- Addison Wesley, 2005.
Course No: SE 204
Course Name: Design Project
Credits: 2(0-1-3)
Course Position: Semester 4

Objectives:
Students will draw upon a combination of methods from engineering design, the allied arts and tools from social sciences to focus on what could actually interest the world of business and trade at large. The process will commence with field visits where they will record their observations and develop empathy for their fellow citizens and their problems. The design lab shall be a place to discover innovative solutions and create rough prototypes. Our emphasis will be on the nature of personal discoveries offered by the students’ teams.

- Develop the ability to work within a team
- Develop scientific interest
- Expose students to complexity (fuzzy problems, multi-solutions problems)
- Expose students to "real life" problems
- Expose students to common place materials that can be repurposed/recycled
- Acquire knowledge in the field of the project
- Introduce a set of key skills to become an innovative engineer: teamwork, communication, complex problem solving and creativity

On completion of the course, students should be able to
- effectively work within a team targeted to one specific scientific problem
- increase their ability to deal with complexity
- being introduced the basics of project management
- test the basics of oral/written communication
- being introduced basics of problem solving

Course Content:
- Develop a set of key skills around a scientific problem
- Elements of Design and Gestalt Laws of Visual Perception
- Studies in Form as 2D and 3D object creations
- Visual Thinking and Techniques of creativity with a special focus on the Indigenous
- Social Sciences and Cognitive Psychology
- Prototyping and the understanding of the Nature of Material Sciences
- Product Planning and working out strategies to market and distribute them
- Teamwork: organize, decide, manage within a team; team member roles and performance
- Written and oral communication
- Creativity: group creativity methods
- Develop scientific interest

**Text Books:** Case studies based teaching and problem based learning.

**References:**

- Managing Complex Projects (The IIL/Wiley Series in Project Management) [Hardcover] International Institute for Learning (Author), Harold R. Kerzner (Author), Carl Belack (Author).
- Project Management: from Simple to Complex, v. 1.0 by Russell Darnall and John M. Preston

**LABORATORY WORK**

It would be a first experience for students of a Science & Tech project. It will require teams of 5 students working on projects proposed by labs, faculty or any scientific/technical stakeholders such as companies. Projects can deal with computing and simulation, small models, technical system study, extensive synthesis of a bibliography, test of concept or... any need from a lab, a faculty member or a company.

That's why there is no list of specific experiment. But we will probably need the lab of Eng. Design set up for some groups, a space for working and for storage.

At the end of the year a report and a defense will take place in front of a jury for evaluation.
Course No: HS 207
Course Name: Modern Culture and Philosophy
Credits: 1.5(1-1-0)
Course Position: Semester 4

Objectives:
This course is an introduction to modern day cultures and the related philosophical background and issues.

Course Content:
Part 1: Modern day digital culture
- Social interaction and friendship
- Personal data and web surveillance
- Communication through digital media
- A new individual and new communities, the rise of the net

Part 2: Modern day philosophical perspectives
- Mass culture (H. Arendt)
- Post-modernism, deconstruction, reconstruction (M. Foucault, J. Derrida, J. Habermas, A. Sen)
- Post-colonialism (E. Saïd, G. Spivak, D. Chakrabarty)

Study Material:
- A Brief History of the Advent of Mass Culture
- Definition and Meaning of Deconstruction
- One essay from Bipan Chandra's *Essays on Colonialism*
- One Post-modern Text to be included

References:

Testing:
Students will be tested in the above concepts and from the texts by way of applying the theories taught to them through written examination. The allocation of marks will be 70:30. 70% written examination and 30% for Oral examination.
Course No: CE 301

Course Name: Earth and Environmental Sciences

Credits: 2 (2-0-0)

Course Position: Semester 5

Objectives:

The aim of this course is to provide the students with the basic knowledge in earth and environmental sciences including the earth system, its geology, surface and underground hydrology and basic observation techniques. A special attention is put to the context of India.

Course Content:

Module 1: The earth system: Earth in the solar system. Atmosphere and oceans: Origin and evolution; Atmosphere-ocean interaction; Air pollution, Green house effect, Ozone layer; Ocean currents and waves. Lithosphere, Hydrosphere, Cryosphere and atmosphere and their Interactions.


Module 3: Natural hazards: Earthquakes: Causes, classification, magnitude, intensity, Historical earthquakes, Seismic hazards zoning, strong ground motion, earthquake prediction. Landslides and Subsidence: Causes, classification and monitoring;

Module 4: Groundwater: Groundwater resources and quality of ground water.

Module 5: Physical Geology- Weathering.


Module 6: Geophysical mapping: seismic, resistivity, radar, geotomography, logging.

Text Book:

- Geology for Geotechnical Engineers, J.C.Harvey, Cambridge University Press.
References:

- Geology, 4th edition, by Chernicoff and Whitney
- Essentials of Geology (11th Edition), Frederick K. Lutgens, Edward J. Tarbuck, Dennis G Tasa
- Principles of Igneous and Metamorphic Petrology (2nd Edition), John D. Winter
- Earth Materials: Introduction to Mineralogy and Petrology, Cornelis Klein, Anthony Philpotts
- Geodynamics, Donald L. Turcotte, Gerald Schubert
- The Solid Earth: An Introduction to Global Geophysics, C. M. R. Fowler
- Sedimentology and Stratigraphy, Gary Nichols
- Geochemistry: An Introduction, Francis Albarède
Course No: MA 305
Course Name: Probability & Statistics
Credits: 4 (3-2-0)
Course Position: Semester 5

Objectives:
This course is an introduction to basic concepts of mathematical randomness and description. It provides the knowledge required to take into account variability in the various engineering fields (uncertainties in simulation, modelling of fluctuating physical phenomena, financial mathematics, etc.). Examples will be taken from appropriate engineering applications and related courses in engineering and physics.

Course Content:

Part 1: real analysis
Sigma-algebra, measures and measurable spaces, Lebesgue integral, Fourier transforms, Hilbert analysis, Sobolev spaces

Part 2: Probability

Part 3: Statistics
Sampling, Estimation, Tests, Adjustment, Regression, Principal Components Analysis

Text Book:
- Statistical Decision Theory and Bayesian Analysis - JO Berger - (Springer Verlag)
- Bayesian Theory - JM Bernardo & AFM Smith - (John Wiley & Sons)
- Statistical Methods: the Geometric Approach - DJ Saville & GR Wood - (Springer Verlag)

References:
- Stochastic Process - JL Doob - (John Wiley & Sons)
- Statistic of Extremes - EJ Gumbel - (Columbia University Press)
Course No: ME 304
Course Name: Multiphysics
Credits: 4 (3-2-0)
Course Position: Semester 5

Course Content:

Part 1: Introduction to continuum mechanics:

Module 1: REV; Cauchy Stress tensor; Strain tensor, strain rate, material and spatial derivatives; General principles, continuity equation, momentum and energy principles, mass-momentum and energy transport theorems,

Module 2: Thermo-Elasticity: Classical elasticity, Generalized Hooke’s law, isotropy, thermal stresses and strain, stress concentration, Boundary value problems.

Part 2: Heat Transfer


Module 5: Convective heat transfer: Dimensional approach to forced convection. Notions of mechanical and thermal boundary layers. Reynolds, Prandtl and Nusselt numbers. Laminar-turbulent transition. Standard cases (tube, flat plate) of internal and external convection in the fully developed regime.


Text Book:

• Som, S. K Introduction To Heat Transfer. Prentice-Hall of India Pvt. Ltd.
• COMSOL multiphysics Manual.

References:

• Landau, Lifchitz (1967) theory of elasticity, Vol 7,
• Incropera, F. P., DeWitt, D. P., Bergman, T. L., & Lavine, A. S. Fundamentals of Heat and Mass Transfer :
• John Wiley & Sons.
• Özisik, M. N. Heat transfer: a basic approach: McGraw-Hill.
Course No: SE 306
Course Name: Team Project Phase I: Introduction to Project management
Credits: 2 (0-2-2)
Course Position: Semester 5

Course Content:

General introduction, systems and processes: systems; processes; economic, environmental and societal values

Demands engineering, conception processes: system engineering, V cycle, functional analysis, AMDEC, life product cycle, conception processes

Industrialization, production: specialized workshops, line of production, MRP, just-in-time, lean, 6sigma, production costs, prices

Supply chain: supply networks, logistical chain, supply decision, operations management, vehicle round problem, shortest way problem

Running, SLI, after sales service: integrated logistical support, owning global cost, maintenance, work safety, availability, reliability, default rate, bayesian networks

Project planning and organization: work breakdown, scheduling, cost and resources planning

Project control: risk management, project quality, project status monitoring and control

Text Book:


References:

- Project Management: A Systems Approach to Planning, Scheduling, and Controlling (11th Edition), Harold Kerzner
- Managing Complex Projects (The IIL/Wiley Series in Project Management) [Hardcover] International Institute for Learning (Author), Harold R. Kerzner (Author), Carl Belack (Author)
- Project Management: from Simple to Complex, v. 1.0 by Russell Darnall and John M. Preston
Project work

SE 306-SE308 consist in a year long project on a topic given by a company or a tutor. Teams of 5 students will work on the actual need of this so-called client. Each project is linked to a specific challenge: Energy, Transportation, Health and other Thrust Areas.

Students will have inputs during the year regarding their professional skills. They will work mostly in autonomy but controlled by regular project reviews.
Course No: SE 308
Course Name: Team Project: Phase II
Credits: 3 (0-3-3)
Course Position: Semester 6

Course Content:

Develop a set of key skills to become an innovative engineer:

Teamwork: organize, decide, manage within a team; team member roles and performance

Written and oral communication: structure and synthesis, increase written and oral impact, interpersonal communication and public communication

Approach to solve complex problems: frame the issue; inductive, experimental and recursive approaches; doubt and complexity

Creativity: group creativity methods

Build one's academic and career plan

Discover the work of an engineer

Understand Centrale's curriculum strengths

Move from an academic paradigm into a professional one

Text Book:
Case studies based teaching and problem based learning

References:
• A Guide to the Project Management Body of Knowledge: PMBOK® Guide (Fifth Edition), PMI Project Management Institute
• Project Management: A Systems Approach to Planning, Scheduling, and Controlling (11th Edition), Harold Kerzner
• Managing Complex Projects (The IIL/Wiley Series in Project Management) [Hardcover] International Institute for Learning (Author), Harold R. Kerzner (Author), Carl Belack (Author)
• Project Management: from Simple to Complex, v. 1.0 by Russell Darnall and John M. Preston
Project work
SE 306-SE308 consist in a year long project on a topic given by a company or a tutor. Teams of 5 students will work on the actual need of this so-called client. Each project is linked to a specific challenge: Energy, Transportation, Health and other Thrust Areas.

Students will have inputs during the year regarding their professional skills. They will work mostly in autonomy but controlled by regular project reviews.
Course No: SE 309
Course Name: Corporate Management and Finance
Credits: 3 (3-0-0)
Course Position: Semester 6

Objectives:
The course provides students with a structured understanding of how companies operate, can be managed, discover criteria of economic performance. It is an introduction to concepts such as governance, strategy, partnering, organizing and to the typology of the various financial resources that are essential for corporate operations and development. In addition, the fundamentals of financial analysis to be able to use financial data for corporate operations are given.

Course Content:

Management

- Introduction: objectives, stakeholders, operations and product life cycles
- Marketing of products and services
- Corporate strategy
- Growth process and strategic maneuvers
- Structure and processes, informal organization
- Performance driving and operations management
- Management of innovation and technology
- Company managers: between projects and responsibilities

Finance

- Accounting practices in companies, especially monetary representation
- Forecasting and company management: principles and practice of basic cost accounting
- Using corporate financial analysis tools: income statement intermediate balance, working capital, changes in working capital, etc.
- Business plan, business model
- Finance a company via equity or debt
- The company in its environment: challenges of globalization, analysis of financial crises and their economic impact on companies

Teaching material & Text Book:

- E-learning modules
Course No: MA 306
Course Name: Partial Differential Equation
Credits: 2 (2-0-0)
Course Position: Semester 6

Objectives:
To use mathematics in the engineer's frame of mind: to model an actual problem, to analyze rigorously, to experiment and to validate the numerical results. The course presents the mathematical bases of the theoretical and numerical analysis of partial differential equations.

Practical classes provide hands on experience with software for numerical computations relevant to specific branches.

On completion of the course, students should be able to
Model, write, analyze and implement a numerical scheme for a simple problem and to use software for numerical simulation.

Course Content:
- Modelling actual problems with PDEs
- Distribution theory
- Cauchy problems
- Elliptic and parabolic problems
- Finite difference and finite element approximation: numerical analysis of approximation schemes

Text Book:
- Equations of Mathematical Physics, by V. S. Vladimirov, Alan Jeffrey.
- Computational methods for partial differential equations by Jain, Iyenger, Jain.

References:
- Partial Differential Equations, Lawrence C. Evans, American Mathematical Society
- Partial Differential Equations, Renuka Ravindran, Phoolan Prasad.
- A course in distribution theory and applications by RS Pathak (Narosa Publishers).
Objectives:

- develop self-confidence and autonomy
- develop awareness of one's strengths and weaknesses
- prepare one's career plan

Course Content:

Module 1: Career Oriental Communication covering, Resume and biodata: Design & style; Applying for a job: Language and format of job application. Job Interviews: purpose and process; How to prepare for interviews; Language and style to be used in interview; Types of interview questions and how to answer them; Group Discussion: structure and dynamics; Techniques of effective participation in group discussion; Preparing for group discussion.

Module 2: personal self-analysis, student's book and resume, summer internship analysis.

Module 3: Self Development and Assessment- Self assessment, Awareness, Perception and Attitudes, Values and belief, Personal goal setting, career planning, Self esteem.

Module 4: Communication and Technical Writing- Public speaking, Group discussion, Oral; presentation, Interviews, Graphic presentation, Presentation aids, Personality Development. Writing reports, project proposals, brochures, newsletters, technical articles, manuals, official notes, business letters, memos, progress reports, minutes of meetings, event report.

Module 5: Ethics- Business ethics, Etiquettes in social and office settings, Email etiquettes, Telephone Etiquettes, Engineering ethics, Managing time, Role and responsibility of engineer; Work culture in jobs, Personal memory, Rapid reading, Taking notes, Complex problem solving, Creativity.

Module 6: Discover the work of an engineer; Alumni careers analysis; job market

Teaching Material and Textbooks

- Fred Luthans, Organizational Behaviour, McGraw Hill
- Lesikar and petit, Report writing for Business
- M. Ashraf Rizvi, Effective Technical Communication, McGraw Hill
- Wallace and masters, Personal Development for Life and Work, Thomson Learning
- Hartman Lemay, Presentation Success, Thomson Learning
MAHINDRA ÉCOLE CENTRALE

- Malcolm Goodale, Professional Presentations
- Farhathullah, T. M. Communication skills for Technical Students
The objective of the course is to familiarize students (Prospective entrepreneurs) with elementary knowledge including laws that would be of utility in their profession.

Module 1: Introduction to Entrepreneurship: Evolution of entrepreneurship from economic theory Managerial and entrepreneurial competencies. Entrepreneurial growth and development. Motivation and obstacles to create a company. Testimonies by entrepreneurs: what to do, what to avoid

Module 2: Financing a start-up, Business, Go to Market: from the product to the client.

Module 3: Constitutional Law; Fundamental Rights, Judicial Activism; Directive principles of State policy; Fundamental Duties; Emergency provisions – kinds, legal requirements and legal effects; Human Rights and Public International Law.

Module 4: General Principles of Contract. Arbitration, Conciliation

Module 5: Law relating to Intellectual property. Right to Information

Module 6: Labour, Corporate and criminal Law.

Text/Reference Books:

- D.D. Basu (1996), Shorter Constitution of India, Prentice Hall of India
- R.R. Pennington, Company Law, Butterworth Publications
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## Electives

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## Course Content:

**Manufacturing properties of Materials:** Structure and properties of engineering materials, heat treatment, stress-strain diagrams for engineering materials.

**Metal Casting:** Design of patterns, moulds and cores; solidification and cooling; riser and gating design, design considerations.

**Forming:** Plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) metal forming processes; principles of powder metallurgy.

**Joining:** Physics of welding, brazing and soldering; adhesive bonding; design considerations in welding.

**Machining and Machine Tool Operations:** Mechanics of machining, single and multi-point cutting tools, tool geometry and materials, tool life and wear; economics of machining; principles of non-traditional machining processes; principles of work holding, principles of design of jigs and fixtures

**Metrology and Inspection:** Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; form and finish measurement; alignment and testing methods; tolerance analysis in manufacturing and assembly.

## Text Book:


## References:

Course No: ME 305
Course Name: Applied Thermodynamics
Credits: 2 (2-0-0)
Course Position: Semester 5

Course Content:

Module 1: Second Law of Thermodynamics- Thermal energy reservoirs, heat engines energy conversion, the Carnot Theorem, the Carnot heat engine and refrigerator, efficiency. Clausius inequality, concept of entropy, reversible and irreversible processes, Entropy change of pure substances, isentropic processes, property diagrams involving entropy, entropy change of liquids and solids and ideal gases, reversible steady-flow work, isentropic efficiencies of steady-flow devices, and entropy balance.

Module 2: Energy - a measure of work potential, including work potential of energy, reversible work and irreversibility, second-law efficiency, exergy change of a system, energy transfer by heat, work, and mass, the decrease of exergy principle and exergy destruction, energy balance: closed systems and control volumes energy balance.


Text Book:

References:

- Potter, M. C., & Somerton, C. W. Schaum's Outline of Thermodynamics for Engineers, McGraw-Hill.
MAHINDRA ÉCOLE CENTRALE

Course No: ME 307
Course Name: Industrial Engineering
Credits: 4(3-2-0)
Course Position: Semester 5

Course Content:

Module 1: General introduction, systems and processes: systems; processes; economic, environmental and societal values

Module 2: Demands engineering, conception processes: system engineering, V cycle, function analysis, AMDEC, life product cycle, conception processes

Module 3: Industrialization, production: specialized workshops, line of production, MRP, just-in-time, lean, 6sigma, production costs, prices

Module 4: Supply chain: supply networks, logistical chain, supply decision, operations management, vehicle round problem, shortest way problem

Module 5: Running, SLI, after sales service: integrated logistical support, owning global cost, maintenance, work safety, availability, reliability, default rate.

Text Book:


References:

MAHINDRA ÉCOLE CENTRALE

Course No: ME 306
Course Name: Fluid Mechanics
Credits: 4 (3-2-0)
Course Position: Semester 5

Objectives:

Fluid mechanics is a central subject in many technological applications. It intervenes in energy conversion, oil exploration, ocean engineering, materials processing, propulsion, aeronautics and space, process engineering, biomechanics and biotechnologies, environment, meteorology, climate change, microfluidics. Its recent developments have been substantial. A number of theoretical problems have been resolved, new experimental methods have provided unique data on many flow processes, novel simulation tools have allowed considerable insights in fundamental and more applied scientific or engineering problems. In this context, a basic understanding of fluid mechanics is essential to engineers and scientists. This course provides the fundamental elements allowing an operational understanding of central issues in this field. The focus is on:

- Physical understanding,
- Training in problem solving,
- Sharing our knowledge and passion for fluid mechanics and its applications.

The course includes detailed presentations of essential aspects in combination with simple experiments, computer demonstrations, fluid mechanics film projections. Problem solving workshops (PSW) are organized after each lecture to train students in tackling real life engineering problems. The midterm and final exams consist in solving practical fluid mechanics problems.

Course Content:

- Macroscopic balance equations. The momentum and moment of momentum theorems. Application to the determination of hydrodynamic forces and moments. Propulsion applications.
Dimensional analysis. A priori estimates fundamental dimensionless groups. The Pi-theorem and its application to the analysis of drag. Model scale testing, similarity conditions. Examples of application of similarity concepts.


Text Book:


References:

- Fluid Mechanics, J. Spurk, N. Aksei, Springer
Course No: ME 313
Course Name: Experimental analysis
Credits: 3 (1-0-4)
Course Position: Semester 6

Objectives:

Teach scientific experimental methodology:

- how to define the problem precisely and the model that should be used
- how to set up the experiments
- how to discuss the experimental results and compare them with other sources
- how to take into account safety issues

Course Content:

This laboratory course deals with the experimental study of the mechanical behaviour of several materials and their effects on the design of complex structures analysed using a computed code. The students can choose three of the following subjects:

Fabrication of a composite material, study of the associated experimental mechanical behaviour and design of a mechanical part.

Study of the experimental mechanical behaviour of a cardboard sheet and design of a bridge.

Experimental study of a steel, influence of thermal treatments on the microstructure and link to the mechanical behaviour.

Experimental study of aluminium, mechanical characterization using digital image correlation, comparison with numerical simulation.

Analysis of the experimental results is complemented with numerical results from finite element software.

Text Book:

- Fundamentals of Structural Mechanics - Keith D. Hjelmstad
- Selected scientific papers
Course No: ME 314  
Course Name: Structural Dynamics and Acoustics  
Credits: 4 (3-2-0)  
Course Position: Semester 6  

Objectives:  
Dynamic vibration and propagation phenomena, in mechanics, play an essential part in many areas: geophysics, building resistance to wind and swell, stability and comfort of aeronautical and terrestrial vehicles, rotating machinery, non-destructive control, ultrasound scan, actuators. The aim of this course is to provide students with essential knowledge and methods for the analysis and quantification of these phenomena in structural dynamics and acoustics.  

Course Content:  
Module 1: Dynamics of rigid bodies: Kinematics, parametric description of rotations, Newton and Euler equation, Lagrange and Hamilton’s equations, moving frames.  
Module 2: small transformation in inertial frames, elastic waves, moving frames, Geometric stiffness and follower forces.  
Module 4: Vibration of beams  
Module 5: Dynamic response of a discrete system to harmonic, transient and stationary random loads.  
Module 6: Acoustics: models and sources, propagation, resonances and wave guides.  
Module 7: Introduction to fluid-structure interaction: light and heavy fluid approximations  

Text Book:  

References:  
Course No: ME 309
Course Name: Advanced Solid Mechanics
Credits: 4(3-2-0)
Course Position: Semester 6

Course Content:

Module 1: Continuum mechanics, Euler-Lagrange maps, tensor analysis, Transformation Gradient, Green-Lagrange strain tensor, compatibility equation, strain rate, Cauchy stress tensors, Principal stresses, Invariants, Mohr circles, deviatoric stress. Failure-Yield criteria, balance of momentum, and mass conservation.

Module 2: Virtual power principles, transport theorems, Clausius-Duhem inequality, static and kinematic limit analysis.

Module 3: Thermo-elasticity, material invariant, Finite strain elasticity, incompressibility, entropic elasticity. Helmholtz Free energy.

Module 4: Linear elastic problems, Boundary conditions, initial conditions, Torsion of beams, stress concentration, cylindrical and spherical shells, Betti-Maxwell reciprocity, Introduction to Ritz-Galerkin method, effect of initial stress. Linear bucking.

Module 5: Advanced beam theory, Saint Venant Principle, Timoshenko and Euler Bernoulli models, Shear stress in cross-sections. Limit analysis for beams, assembly of beams, curved beams and arches.

Modules 6: membranes, plates and thin shells.

Text Book:

- Fundamentals of Structural Mechanics - Keith D. Hjelmstad
- Bruhns, O. T. Advanced mechanics of solids: Springer.
- Cook, R. D., & Young, W. C. Advanced mechanics of materials: Macmillan.
- Ugural, A. C., & Fenster, S. K. Advanced strength and applied elasticity: PTR Prentice Hall.
- Boresi, A. P., Schmidt, R. J., & Sidebottom, O. M. Advanced Mechanics of Materials: John Wiley
- Solecki, R., & Conant, R. J. Advanced mechanics of materials: Oxford University Press.

- Landau, Lifchitz (1967) theory of elasticity, Vol 7,
- Washizu K. (1975) Variational Methods In Elasticity And Plasticity, Pergamon Press
- W Michael Lai; Introduction to Continuum Mechanics, Fourth Edition,
Course No: ME 410
Course Name: Finite Element Method in Engineering
Credits: 4 (3-2-0)
Course Position: Semester 7

Objectives:

The finite element method has become a method of choice for computational engineering and science simulations. The main objective of the course is to develop skills to effectively use the finite element method for the analysis of problems in solid and fluid mechanics. Students will learn the basic principles of the method, how to develop suitable finite element models, and how to interpret the numerical results. A second objective is to familiarize students with the COMSOL Multiphysics software. The skills acquired in this course will be useful for the supervision of conception and design projects.

Course Contents

The course will present the main theoretical aspects of the finite element method and its application to engineering problems using COMSOL Multiphysics. Topics will include:

- Variational formulation of classical 1D BVPs
- Finite element space and solution procedures
- Variational formulation of classical 2D BVPs
- Finite elements in 2D and in 3D
- Matrix assembly
- Mesh generation, convergence analysis, and discretization errors
- Initial and boundary-value problems
- Multimodel/multiphysics applications

The theory will be illustrated by the development of COMSOL models drawn from applications in solid and fluid mechanics such as: linear elastic stress analysis, large deformations, thin plate and shell modeling, heat transfer, incompressible flows, etc.

Text/Reference Books:

- Chandrupatla T.R., and Belegundu A.D., Introduction to Finite Elements in Engineering, Pearson Education
- Logan D.L., A First course in the Finite Element Method, Third Edition, Thomson Learning,
  problems, Vol.1, Butterworth Heineman.
1994.

Course No: ME 411

Course Name: Advanced Manufacturing Engineering

Credits: 3 (3-0-0)

Course Position: Semester 7

Course Content:

Computer Integrated Manufacturing: Basic concepts of CAD/CAM and their integration tools.

Metal Casting: Gating design, cooling and solidification especially for center line feeding resistance, continuous casting process, riser design and placement.


Joining: Analysis of either one of thick plate welding or thin plate welding.

Machining and Machine Tool Operations: Cutting force analysis for single point and multipoint tools. Machine tool vibrations (chatter theory).

Non-conventional Machining processes: Several non-conventional processes will be covered based on the preferences of the individual instructor. Suggested processes include EDM & WEDM, ECM, USM, AJM, WJM, LBM, EBM, PAM, etc.

Text Book:


References:

Course No: ME 412  
Course Name: Advanced mechanics of materials  
Credits: 3(2-2-0)  
Course Position: Semester 7  

Course Objectives

Due to service life, high performance and low cost requirements, today engineers cannot design mechanical structures only through elasticity assumptions. The objective of this course is to highlight the mechanical behaviour of the main classes of materials under different loading conditions, to understand the physical basis of the micromechanisms involved, and to use relevant modelling for design, in the framework of numerical methods.

On completion of the course, students should be able to

- understand the non-linear mechanical behavior of materials: plasticity, anisotropy, fracture, design for extreme loadings
- analyse experimental results
- analyse numerical results from Finite Element Method modeling
- understand relationship between mechanical properties and physical micromechanisms
- choose and use the relevant model for structural design

Course Contents

- Thermal loading and thermo-elasticity
- Light structures: anisotropic elasticity of composite materials
- Polymers and elastomers elasticity
- Plasticity of metallic crystals and alloys
- Computation of irreversible strains
- Design of a structure by finite elements
- Crack tolerance: fracture mechanics
- Prediction of the lifetime under cyclic solicitation: creep

Teaching Material and Textbooks

- Chaboche and Lemaître, Mechanics of Materials, Dunod
- Chakrabarty J., Applied Plasticity; Springer-Verlag
- R. Hill; The Mathematical Theory of Plasticity, Oxford University
The object of Project Work I is to enable the student to take up investigative study in the broad field of Computer Science & Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include:

- Survey and study of published literature on the assigned topic;
- Working out a preliminary Approach to the Problem relating to the assigned topic;
- Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility;
- Preparing a Written Report on the Study conducted for presentation to the Department;
- Final Seminar, as oral Presentation before a Departmental Committee.
Course No: ME 422

Course Name: Departmental Project work 4: Phase II

Credits: 5 (0-0-10)

Course Position: Semester 8

The object of Project Work II & Dissertation is to enable the student to extend further the investigative study taken up under EC P1, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

- In depth study of the topic assigned in the light of the Report prepared under XX 421;
- Review and finalization of the Approach to the Problem relating to the assigned topic;
- Preparing an Action Plan for conducting the investigation, including team work;
- Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed;
- Final development of product/process, testing, results, conclusions and future directions;
- Preparing a paper for Conference presentation/Publication in Journals, if possible;
- Preparing a Dissertation in the standard format for being evaluated by the Department;
- Final Seminar Presentation before a Departmental Committee
Course No: ME 414
Course Name: Design of Machine Elements
Credits: 3(3-0-0)
Course Position: Semester 8

Course Objectives


Module 2: Design procedure and applications of Statically Loaded Machine Elements- Design of elements subjected to simple loading: Riveted joints, Screws including power screws Bolted joints including eccentrically loaded joints, Axles, and coupling, Clutches and brakes.

Module 3: Fatigue- Introduction to design for fatigue strength. Endurance and modifying factors. Surface strength. Review of design procedure of fatigue failure with application to the design of bolts and springs subjected to fatigue loading.

Module 4: Design procedure and applications of Dynamically Loaded Machine Elements. Shafts, Spur, helical, bevel and worm gears, Journal and rolling contact bearings, Belts and chains. Assemblies of various machine elements like those of a screw jack and a gear box.

Text/Reference Books:

Course No: ME 433
Course Name: Introduction to IC Engines
Credits: 4 (3-2-0)
Course Position: Semester 8

Course Content:


Module 4: Engine systems and components-Ignition system. (battery, magneto & electronic); Lubrication system; Engine starting system; Engine cooling system; Governing system (quality and quantity hit & miss governing); Intake and exhaust systems (two valves & four valves); Drive train (cam shaft, valves etc.)

Module 5: Performance characteristics & Testing of I.C. Engines-Introduction to Indian. Standards for testing of I.C. Engine, Mean effective pressure, indicated power, brake power, friction power, Methods to determine power and efficiencies Variables affecting performance of engine, characteristic curves, heat balance sheet, Methods of improving engine performance; super & turbocharged engines.

Text/Reference Books:

- Lumley, J. L;Engines: an introduction: Cambridge University Press.
- Stone, R. Introduction to internal combustion engines:
Course No: ME 435
Course Name: Refrigeration & Air Conditioning
Credits: 4 (3-2-0)
Course Position: Semester 8

Course Content:

Part A: Refrigeration

Module 1: Introduction- Necessity and applications; Module of refrigeration and C.O.P. Mechanical Refrigeration; Types of Ideal cycles of refrigeration. Air Refrigeration: Bell Coleman cycle and Brayton Cycle, Open and Dense air systems; Actual air refrigeration system problems; Refrigeration needs of Aircrafts.

Module 2: Vapour Compression Refrigeration- Working principle and essential components of the plant; Simple Vapour compression refrigeration cycle; COP; Representation of cycle on T-S and h charts; effect of sub cooling and super heating; cycle analysis; Actual cycle Influence of various parameters on system performance; Use of p-h charts; numerical Problems.


Module 4: Vapor Absorption Refrigeration- Calculation of max COP; description and working of NH3; water system and Li Br; water (Two shell & Four shell) System. Principle of opération Three Fluid absorption system, salient features.

Module 5: Other Refrigeration Systems- Steam Jet Refrigeration System; Working Principle and Basic Components. Principle and operation of (i) Thermoelectric refrigerator (ii) Vortex tube or Hilsch tube.

Part B: Air Conditioning

Module 1: Introduction- Psychometric Properties & Processes; Characterization of Sensible and latent heat loads; Need for Ventilation, Consideration of Infiltration; Load concepts of RSHF, GSHF- Problems, Concept of ESHF and ADP. Requirements of human comfort and concept of effective temperature; Comfort chart; Comfort Air conditioning; Requirements of Industrial air conditioning;

Text/Reference Books:

- Lumley, J. L; Engines: an introduction: Cambridge University Press.
- Stone, R. Introduction to internal combustion engines:
- Whitman, W. C., Johnson, W. M., & Tomczyk, J. Refrigeration & air conditioning technology: Delmar
Course No: ME 437
Course Name: Introduction to Operations Research
Credits: 4 (3-2-0)
Course Position: Semester 8

Course Content:

Module 1: Overview of Operations Research Modeling

Module 2: Linear programming: The Simplex Method, Duality and Sensitivity Analysis.

Module 3: Other algorithms for linear programming such as the Dual Simplex method, Parametric Linear Programming, The Upper Bound Technique, etc.

Module 4: The Transportation and Assignment Problems

Module 5: Network Optimization Models

Module 6: Project Management with PERT/CPM

Module 7: Rudiments of a few of the following topics: Dynamic programming, Integer programming, Nonlinear programming, Game theory, Markov Chains, Queueing theory, Inventory theory, and Forecasting.

Text/Reference Books:

Course No: ME 431
Course Name: Turbomachinery
Credits: 4 (3-2-0)
Course Position: Semester 7

Course Content:

Module 1: Introduction to Turbomachines. Classification of Turbomachines. Second Law of Thermo
dynamics, turbine/compressor work, Nozzle/diffuser work. Fluid equations: continuity, Euler's,
Bernoulli's equation and its applications. Expansion and compression processes, Reheat Factor, Preheat
Factor.

Module 2: Euler's Equation of Energy Transfer, vane congruent flow, influence of relative circulation,
thickness of vanes, number of vanes on velocity triangles, slip factor, Stodola, Stanitz and Balje's slip
factor. Suction pressure and net positive suction head. Phenomena of cavitation in pumps. Concept of
specific speed, Shape number. Axial, Radial and Mixed Flow Machines. Similarity laws.

circulation and ventilation. Stage pressure rise and work done. Slip stream and Blade Element theory for
propellers. Performance and characteristics of Axial fans.

Module 4: Flow through Centrifugal compressors. Stage velocity triangles, specific work. forward, radial
and backward swept vanes. Enthalpy entropy diagram, degree of reaction, slip factor, efficiency. Vane
less and vaned diffuser systems, volute as spiral casing. Surge and stall in compressors

Module 5: Axial turbine stages, stage velocity triangles, work, efficiency, blade loading, flow coefficient.
Single stage impulse and reaction turbines, degree of reaction, 50% reaction turbine stage, Radial
equilibrium and Actuator disc approach for design of turbine blades. Partial admission problems in
turbines. Losses in turbo machines.

Text book:
An Introduction to Energy Conversion: Turbomachinery, Volume 3

Reference books:
Sheppard, Principles of Turbomachinery.

Course No: ME 432
Course Name: Theory of machines
Credits: 3 (3-0-0)
Course Position: Semester 8

Course Content:

Module 1: Introduction- General concepts, Introduction to simple mechanism, Different types of Kinematics pair, Grublers rule for degree of freedom, Grashof’s criterion for mobility determination. Inversions of 3R-P, 2R-2P chains.

Module 2: Kinematic Analysis- Concepts of vectorial analysis. Velocity and Acceleration Analysis of planar mechanisms.

Module 3: Cams- Classification, Cams with uniform acceleration and retardation, SHM, Cycloidal motion, oscillating followers.

Module 4: Vibrations- Vibration analysis of SDOF systems, Natural, damped forced vibrations, Based-excited vibrations, transmissibility ratio.

Module 5: Gears- Geometry of tooth profiles, Law of gearing, Involute profile, interference, helical, spiral and worm gears, simple, compound gear trains. Epicyclic gear trains – Analysis by tabular and relative velocity method, fixing torque.

Module 6: Dynamic Analysis- Slider-crank mechanisms, turning moment computations.

Module 7: Balancing- Static and Dynamic balancing Balancing of revolving & reciprocating masses in single and multi-cylinder engines.

Module 8: Gyroscopes- Basic concepts Gyroscopic law, effect of gyroscopic couple on automobiles, ships, aircrafts.

Text Book:


Reference Books:

- Bevan, T. The Theory of Machines: A Text-Book for Engineering Students: Pearson Education
• Vinogradov, O. G. Fundamentals of Kinematics and Dynamics of Machines and Mechanisms, CRC Press
Course No: ME 434
Course Name: Power Plant Engineering
Credits: 4 (3-2-0)
Course Position: Semester 8

Course Content:

Objective: Familiarization with the layout, components, and operations of power plants

Module 1: Introduction to Power Plants and Boilers
Layout of Steam, Hydel, Diesel, MHD, Nuclear and Gas turbine Power Plants
Combined Power cycles: comparison and selection, Load duration curves, Steam boilers and cycles, High pressure and Super Critical Boilers, Fluidised Bed Boilers

Module 2: Steam Power Plants
Fuel and ash handling, Combustion Equipment for burning coal, Mechanical Stokers, Pulveriser, Electrostatic Precipitator, Draught- Different Types, Surface condenser types, cooling Towers

Module 3: Nuclear Power Plants
Nuclear Energy-Fission, Fusion Reaction, Types of Reactor, Pressurized water reactor,
Boiling water reactor, Waste disposal and safety

Module 4: Hydel Power Plants
Hydel Power plant- Essential elements, Selection of turbines, governing of Turbines,

Module 5: Diesel and Gas Turbine Power Plants
Types of diesel plant, components, Selection of Engine type. Gas turbine power plant:
Fuels, Gas turbine material, Open and closed cycles, Reheating, Regeneration and Intercooling, Combined cycle

Module 6: Non-traditional Power Plants: Geo thermal, Tidal, and Solar Power Plants

Module 7: Economics of Power Plants
Cost of electric Energy, Fixed and operating costs, Energy rates, Types tariff, Economics of load sharing, Comparison of various power plants.
Text book:

Reference Books: