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).
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 3rd and final year project in 4th 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 semester 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:</th>
<th>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>
<td>0</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 g1, g2, g3, g4, and g5 in five courses and the corresponding credits are c1, c2, c3, c4, and c5, the SPI is given by

$$SPI = \frac{c1g1+c2g2+c3g3+c4g4+c5g5}{c1+c2+c3+c4+c5}$$

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:
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 bonafidé 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 year of study period based on their academic performance and review of the MEC management.
### Semester 1

<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 101 Math I: Calculus &amp; Ordinary Differential Equations</td>
<td>4</td>
<td>2</td>
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<td>5</td>
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<tr>
<td>2</td>
<td>PH 101 Physics I: Mechanics &amp; Thermodynamics</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>6</td>
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<tr>
<td>3</td>
<td>EE 101 Basic Electrical Engineering</td>
<td>2</td>
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<tr>
<td>4</td>
<td>ME 101 Introduction to Engineering Design</td>
<td>2</td>
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<td>5</td>
<td>SE 101 Introduction to Society &amp; Technology</td>
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<td>6</td>
<td>HS 101 Literature &amp; Philosophy</td>
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<td>7</td>
<td>HS 102 French Language &amp; Culture</td>
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**Total Credits: 21**

### Semester 2

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<th>Credits</th>
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<tbody>
<tr>
<td>1</td>
<td>MA 102 Math II - Linear Algebra &amp; Applied Analysis</td>
<td>4</td>
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<tr>
<td>2</td>
<td>CB 101 Chemistry</td>
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<td>3</td>
<td>EE 102 Electronics</td>
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<tr>
<td>4</td>
<td>CS 101 Introduction to Computer Sciences</td>
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<td>SE 102 Media Project</td>
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**Total Credits: 21**
### Semester 3

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<tbody>
<tr>
<td>1</td>
<td>MA 203 Math III –Real Analysis &amp; Algebra</td>
<td>4</td>
<td>2</td>
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<tr>
<td>2</td>
<td>PH 202 Physics II: Electromagnetism &amp; Optics</td>
<td>4</td>
<td>2</td>
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<td>ME 202 Solid Mechanics &amp; Fluid Mechanics</td>
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<td>4</td>
<td>EE 203 Signals &amp; Systems</td>
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Total Credits: 22

### Semester 4

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<tr>
<td>1</td>
<td>MA 204 Math IV -Computational Methods &amp; Discrete Mathematics</td>
<td>3</td>
<td>2</td>
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<td>5</td>
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<tr>
<td>2</td>
<td>CB 202 Biology</td>
<td>2</td>
<td>0</td>
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<tr>
<td>3</td>
<td>PH 203 Physics III: Introduction to Modern Physics</td>
<td>2</td>
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<tr>
<td>4</td>
<td>ME 203 Material Sciences</td>
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<td>5</td>
<td>CS 202 Data Structures and Algorithms</td>
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<td>EE 204 Networks &amp; Filters</td>
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<td>SE 204 Design Project</td>
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<tr>
<td>8</td>
<td>HS 207 Modern Culture &amp; Philosophy</td>
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Total Credits: 22
## Semester 5

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<tbody>
<tr>
<td>1</td>
<td>MA 305 Math V - Probability &amp; Statistics</td>
<td>3</td>
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<tr>
<td>2</td>
<td>CE 301 Earth and Environmental Sciences</td>
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<td>3</td>
<td>ME 304 Multiphysics</td>
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<td>EE 305 Digital Signal Processing</td>
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<td>HS 310 French Language &amp; Culture</td>
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**Total Credits:** 22

## Semester 6

<table>
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<th>Code</th>
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<td>1</td>
<td>MA 306 Math VI - Partial Differential Equations</td>
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<tr>
<td>2</td>
<td>EE 307 Electromagnetic Theory</td>
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**Course No:** PH 101  
**Course Name:** Physics I: Mechanics & Thermodynamics  
**Credits:** 6 (4-2-2)  
**Course Position:** Semester 1

**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 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.
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: Basic Electrical Engineering
Credits: 3.5 (2-1-2)
Course Position: Semester 1

Objective:
The objective of this course is to learn basics of electricity and electrical circuits. The course is based on lectures, exercises and labs courses. 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.

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 Books:

- 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: Introduction to Engineering Design  
Credits: 3 (2-0-2)  
Course Position: Semester 1  

Course Content:

Engineering graphics:

The principles of projections: projections of points, lines, and planes. Parallel and Oblique projections. Orthographic projections in the first and third angles. Isometric projections. Conversions between orthographic and isometric views. Sectional views in orthographic projection. Perspective views and the concept of the vanishing point. Use of computer graphics software to create 2-dimensional drawings. Exposure to a 3-dimensional solid modelling software is an option left to the instructor.

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.

A project component of this course will require the student to design and build a prototype to address a stated need.

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
Course No: SE 101
Course Name: Media Project and Introduction to 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 artefacts 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 one visual project: An audio visual exercise of 30 seconds duration with 5 images spelling out their social concern towards Science and Technology. 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.
- Elements of visual thinking. What are the elements of composition? Still versus moving images
- How does Nature provide us frameworks for composing a
- How do the other Arts influence our ways of visualization and creative articulation?
- 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
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:

Course No: MA 102  
Course Name: Mathematics II (Linear Algebra and Applied Analysis)  
Credits: 5 (4-2-0)  
Course Position: Semester 2

Objectives:

- 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
Course No: EE 102
Course Name: Electronics
Credits: 3.5 (2-1-2)
Course Position: Semester 2

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
5. R. S. Sedha (2010), A Text Book of Electronic Devices and Circuits, S.Chand & Co.

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:

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:
  - Design of (arguably correct) algorithms as solutions to problems
  - Use of abstraction and data organization for implementing algorithms
  - 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 artefacts 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.  
- Elements of visual thinking. What are the elements of composition? Still versus moving images  
- How does Nature provide us frameworks for composing a  
- How do the other Arts influence our ways of visualization and creative articulation?  
- 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

Text Book:

- 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

The objective of this course is to introduce and present the basics of Fields and Waves in the context of Electromagnetism and Optics.

Course Contents

Electro- and Magneto-statics

Physical definitions of Gradient, divergence and curl operators, curvilinear coordinates, Coulomb’s law and principle of superposition, Gauss’s law and its applications, Electric potential and electrostatic energy, Poisson’s and Laplace’s equations with simple examples, uniqueness theorem, boundary value problems, Properties of conductors.

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 forms, 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., Poynting 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, wavefront 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 books:

- Introduction to Electrodynamics: D.J. Griffiths

References:

- Feynman Lectures
- Electricity and Magnetism: Purcell (Berkeley Series)
- Electricity and Magnetism: Mahajan and Rangwala

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 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:

- 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
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 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, Trigonalization 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
- Fluid Mechanics-Fundamentals & Applications , Yunus A. Cengel & John M Cimbala, McGraw Hill,
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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<tr>
<th>Lectures (hr)</th>
<th>Tutorials (hr)</th>
<th>Lab work</th>
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| **Introduction**
Signals and systems: two related concepts. Examples, modelling (organization, simplification, owing to objectives), classical signal processing structure | 1 | |
| **Signal and system Time Representations**
State space representation, properties, relation with input output transfer function | 5 | 2 |
| **Signal and system Spectral Representations**
Fourier transform: definition, existence and properties (absolutely integrable signals). Energy, power density, Parseval relation. Notion of frequency response, ideal filtering (low pass, high pass, band pass ...).
Laplace transform: definition, existence and properties, symbolic calculus, initial and final value theorems. Transfer function. Stability of a linear time invariant system: BIBO stability, stability criteria, characteristic equation, pole positions. | 3 | 3 |
| **Identification**
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 method. Rules for asymptotic Bode diagram. | 8 | 4 | 1 |
### Notion about feedback control

- Design of a closed loop structure: actuation/direct transfer function, feedback.
- Open loop and closed loop transfer functions.
- Performance analysis of a feedback system:
  - Stability, Nyquist criterion, stability margins
  - Precision, steady state error in response to canonical signals (step, ramp, sinus) as reference or disturbance input. Influence of the class of the open loop transfer function. Design of control law: proportional, proportional integrator regulator, lead compensator. State feedback control.

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#### 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

- Transient and Harmonic analysis. Frequency response representation: Black, Nyquist, Bode diagrams.

#### 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, Gestalt laws of visual perception, Visual Arts, Problem Solving with random shapes, Object Sketching, idea Sketching

Module 2: Studies in FORM, 3D Composition, Theory of Solids, Geometrical constructions, Problem Solving of 3D shape corners, edges, planar qualities,

Module 3: People Studies: Ethnography, Interaction Observations and Participatory Methods

Module 4: Prototyping: Concept Prototype, Low Fidelity Mocks, Interaction Mocks, Prototype testing, 3D resolution of a problem

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

Module 6: Product Planning/positioning and marketing Market Analysis, Customer Feedback and retention techniques, Market Segmentation,

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 econom, 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 view points: 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.

Teaching Material and Textbooks
- 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 tools 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.  

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:

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 measure the hardness of various samples.

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.


Experiment 8. Permeability measurement and BH loops of ferrites at high frequency.

Experiment 9. Impedance measurement using impedance analyzer for any dielectric materials, losses and ferro electric loops.

Experiment 10. Magnetization and Curie temperature measurement using simple approach

Experiment 11. Density measurement using Arcedemis principal

Experiment 12. Particle and surface size measurement by Zeta potential

Experiment 13. Surface properties of materials. Study the influence of surface chemistry on the interfacial properties. Demonstration of *lotus effect*. 
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:

References:

- Landau, Lifchitz (1967) theory of elasticity, Vol 7,

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:
- 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)
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- 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.
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).
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:
- 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)
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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: HS 420
Course Name: Communication skills and Personality development
Credits: 2(1-2-0)
Course Position: Semester 7

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

Course Contents
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
- Malcolm Goodale, Professional Presentations
- Farhathullah, T. M. Communication skills for Technical Students
Course No: SE 410
Course Name: Entrepreneurship, IPR & Law
Credits: 3 (3-0-0)
Course Position: Semester 8

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
### Departmental Courses

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### MAHINDRA ÉCOLE CENTRALE

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Course No: EE 204
Course Name: Networks & Filters
Credits: 3 (2-2-0)
Course Position: Semester 4

Course Content

TRANSIENT RESPONSE: Transient Response of RC, RL, RLC Circuits to various excitation signals such as step, ramp, impulse and sinusoidal excitations using laplace transform.

Module 2: NETWORK FUNCTIONS: Terminal pairs or Ports, Network functions for one-port and two-port networks, poles and zeros of Network functions, Restrictions on pole and zero Locations for driving point functions and transfer functions, Time domain behavior from the pole-zero plot.


Module 4: TYPES OF FILTERS AND THEIR CHARACTERISTICS: Filter fundamentals, high-pass, low-pass, band-pass, and band-reject Filters.

NETWORK SYNTHESIS: Positive real functions, synthesis of one port and two port networks, elementary ideas of Active networks.

Text Books:
- Network Analysis & Synthesis: Umesh Sinha; Satya Prakash Pub.
- Network Analysis & Synthesis: F.F.Kuo; John Wiley & Sons Inc.

Reference Books:
- Introduction to modern Network Synthesis: Van Valkenburg; John Wiley
- Network Analysis: Van Valkenburg; PHI
- Basic circuit theory: Dasoer Kuh; McGraw Hill.
- A Course in Electrical Circuit Analysis by Soni & Gupta; Dhanpat Rai Publication.
- Networks and Systems: D.Roy Choudhury; New Age International
Course No: EE 305  
Course Name: Digital Signal Processing  
Credits: 4 (3-2-0)  
Course Position: Semester 5

Course Content


Module 2: Time Domain Representation of Signals & Systems- Discrete Time Signals, Operations on Sequences, the sampling process, Discrete-Time systems, Time-Domain characterization of LTI Discrete-Time systems, state-space representation of LTI Discrete-Time systems, random signals.

Module 3: Transform-Domain Representation of Signals-The Discrete-Time Fourier Transform, Discrete Fourier Transform, DFT properties, computation of the DFT of real sequences, Linear Convolution using the DFT. Z-transforms, Inverse ztransform, properties of z-transform, transform domain representations of random signals. Transform-Domain Representation of LTI Systems: the frequency response, the transfer function, types of transfer function, minimum-phase and maximum-Phase transfer functions, complementary transfer functions, Discrete-Time processing of random signals.


Text Books:
- Proakis J.G., and Manolakis, Introduction to DSP, PHI, 2007

Reference Books:
- Allan Y. Oppenheim & Ronald W. Schater , "Applications DSP”.
- C.Sydney Burrus (Eds), DSP and Digital Filter Design
Course No: EE 306  
Course Name: Linear IC Design  
Credits: 4 (3-2-0)  
Course Position: Semester 5  

Course Content  

UNIT-II : OP-AMP WITH NEGATIVE FEEDBACK AND FREQUENCY RESPONSE: Block diagram representation of feedback amplifier, voltage series feedback, voltage shunt feedback differential amplifiers, frequency response compensating network, frequency response of internally compensative op-amp and non compensating op-amp. High frequency op-amp equivalent circuit, open loop gain V/s frequency, closed loop frequency response, circuit stability, slew rate.

UNIT-III : OP-AMP APPLICATION: DC, AC amplifiers, peaking amplifier, summing, scaling, averaging and instrumentation amplifier, differential input output amplifier, voltage to current converter, current to voltage converter, very high input impedance circuit, integration and differential circuit, wave shaping circuit, active filters, oscillators.

UNIT-IV: SPECIALIZED LINER IC APPLICATIONS: 555 timer IC (monostable & astable operation) & its applications, Universal active filter, PLL, power amplifier, 8038 IC.

Text/Reference Books:
- R.A. Gayakwaed, OP-amps and Linear Integrated circuits.
Course No: EE 307
Course Name: Electro Magnetic Theory
Credits: 2 (2-2-0)
Course Position: Semester 6

Course Content
Module 1: Introduction to Electromagnetic and field Theory;

Module 2: Transmission Lines- Equations of Voltage and Current on TX line, Propagation constant, Characteristic impedance and reflection coefficient, Impedance Transformation, Loss-less and Low loss Transmission line and VSWR, Power transfer on TX line, Smith Chart, Admittance Smith Chart, Applications of transmission lines, Impedance Matching, Lossy transmission line, Problems on Transmission line, Types of transmission line.


Module 4: Uniform Plane Wave- Uniform plane wave, Propagation of wave, Wave polarization, Pioncere's Sphere, Wave propagation in conducting medium, Wave propagation and phase velocity, Power flow and Poynting vector, Surface current and power loss in a conductor

Module 5: Plane Waves at a Media Interface- Plane wave in arbitrary direction, Plane wave at dielectric interface, Reflection and refraction at media interface, Total internal reflection, Polarization at media interface, Reflection from a conducting boundary.

Module 6: Waveguides- Parallel plane waveguide, Wave propagation in parallel plane waveguide, Analysis of waveguide general approach, Rectangular waveguide, Modal propagation in rectangular waveguide, Surface currents on the waveguide walls, Field visualization and Attenuation in waveguide, Attenuation in waveguide continued.

Module 7: Radiation- Solution for potential function, Radiation from the Hertz dipole, Power radiated by hertz, dipole, thin linear antenna, Radiation Parameters of antenna, receiving antenna, Monopole and Dipole antenna, Fourier transform relation between current and radiation pattern.

Text/Reference Books:
- David Cheng, Electromagnetics, Prentice Hall
Course No: EE 309
Course Name: Digital electronics & Microprocessors
Credits: 4 (3-2-0)
Course Position: Semester 6

Course Content
Module 1: Introduction- Digital Systems; Data representation and coding; Logic circuits, integrated circuits; Analysis, design and implementation of digital systems; CAD tools. Number Systems and Codes- Positional number system; Binary, octal and hexadecimal number systems; Methods of base conversions; Binary, octal and hexadecimal arithmetic; Representation of signed numbers; Fixed and floating point numbers; Binary coded decimal codes; Gray codes; Error detection and correction codes - parity check codes and Hamming code. Overview of microcomputer systems and their building blocks, Memory interfacing, concepts of interrupts and Direct Memory Access, instruction sets of microprocessors (with examples of 8085 and 8086);

Module 2: Combinatorial Logic Systems- Definition and specification; Truth table; Basic logic operation and logic gates. Boolean Algebra and Switching Functions- Basic postulates and fundamental theorems of Boolean algebra; Standard representation of logic functions - SOP and POS forms; Simplification of switching functions - K-map and Quine-Mccluskey tabular methods; Synthesis of combinational logic circuits.

Module 3: Logic families-Introduction to different logic families; Operational characteristics of BJT in saturation and cut-off regions; Operational characteristics of MOSFET as switch; TTL inverter - circuit description and operation; CMOS inverter - circuit description and operation; Structure and operations of TTL and CMOS gates; Electrical characteristics of logic gates – logic levels and noise margins, fan-out, propagation delay, transition time, power consumption and power-delay product. Combinational Logic Modules and their applications- Decoders, encoders, multiplexers, demultiplexers and their applications; Parity circuits and comparators; Arithmetic modules- adders, subtractors and ALU; Design examples.

Module 4: Sequential Logic systems- Definition of state machines, state machine as a sequential controller; Basic sequential circuits- latches and flip-flops: SR-latch, D-latch, D flip-flop, JK flip-flop, T flip-flop; Timing hazards and races; Analysis of state machines using D flip-flops and JK flip-flops; Design of state machines - state table, state assignment, transition/excitation table, excitation maps and equations, logic realization; Design examples. State machine design approach-Designing state machine using ASM charts; Designing state machine using state diagram; Design examples.

Module 5: Interfacing with peripherals - timer, serial I/O, parallel I/O, A/D and D/A converters, Arithmetic Coprocessors; System level interfacing design;

Text/Reference Books:
Course No: EE 411
Course Name: Embedded systems design

Credits: 4 (3-2-0)

Course Content


UNIT 2: MICROCONTROLLER ARCHITECTURE: Introduction to PIC microcontrollers, Architecture and pipelining, program memory considerations, Addressing modes, CPU registers, Instruction set, simple operations.

UNIT 3: INTERRUPTS AND I/O PORTS: Interrupt logic, Timer 2 scalar initialization, IntService Interrupt service routine, loop time subroutine, External interrupts and timers, Synchronous serial port module, Serial peripheral device, O/p port Expansion, I/p port expansion, UART.

UNIT 4: PROGRAMMING WITH MICROCONTROLLERS: Arithmetic operations, Bit addressing, Loop control, Stack operation, Subroutines, RAM direct addressing, state machines, Oscillators, Timer Interrupts, Memory mapped I/O. DESIGNING USING MICROCONTROLLERS: Music box, Mouse wheel turning, PWM motor control, Aircraft Demonstration, ultra sonic distance measuring, Temperature Sensor, Pressure Sensor.

Text Books:
- Design with PIC Microcontrollers by John B. Peatman, Pearson.

Text/Reference Books:
- 1. Programming and Customizing the 8051 Microcontroller: Predko; TMH.
- 2. Designing Embedded Hardware: John Catsoulis; SHROFF PUB. & DISTR. ND.
- 3. Programming Embedded Systems in C and C++: Michael Barr; SHROFF PUB. & DISTR. ND.
Course No: EE 308
Course Name: Communication theory I
Credits: 4 (3-2-0)
Course Position: Semester 6

Course Content

Module 2: Review of probability and random process. Gaussian and white noise characteristics. Noise in amplitude modulation systems. Noise in Frequency modulation systems. Pre-emphasis and De-emphasis. Threshold effect in angle modulation.


Module 4: Coherent communication with waveforms - Probability of Error evaluations. Baseband Pulse Transmission - Inter symbol Interference and Nyquist criterion.

Module 5: Pass band Digital Modulation schemes - Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying.


Text/Reference Books:
Course No: EE 333
Course Name: Semi-conductor Processing
Credits: 3 (2-2-0)
Course Position: Semester 6

Course Content:

**Module 1:** Environment for VLSI Technology: Clean room and safety requirements. Wafer cleaning processes and wet chemical etching techniques.

**Module 2:** Impurity incorporation: Solid State diffusion modeling and technology; Ion Implantation modeling, technology and damage annealing; characterization of Impurity profiles.

**Module 3:** Oxidation: Kinetics of Silicon dioxide growth both for thick, thin and ultrathin films. Oxidation technologies in VLSI and ULSI; Characterization of oxide films; High k and low k dielectrics for ULSI.

**Module 4:** Lithography: Photolithography, E-beam lithography and newer lithography techniques for VLSI/ULSI; Mask generation.

**Module 5:** Chemical Vapour Deposition techniques: CVD techniques for deposition of polysilicon, silicon dioxide, silicon nitride and metal films; Epitaxial growth of silicon; modelling and technology.

**Module 6:** Metal film deposition: Evaporation and sputtering techniques. Failure mechanisms in metal interconnects; Multi-level metallisation schemes.

**Module 7:** Plasma and Rapid Thermal Processing: PECVD, Plasma etching and RIE techniques; RTP techniques for annealing, growth and deposition of various films for use in ULSI.

**Module 8:** Process integration for NMOS, CMOS and Bipolar circuits; Advanced MOS technologies.

Text/Reference Books:
Course No: EE 420
Course Name: Experiments in Communication Engineering
Credits: 3 (1-0-4)
Course Position: Semester 7

Course Objective:

Teach Scientific experimental methodology.

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

Course Content:

1. Experiments based on analog communication techniques
2. Experiments based on digital communication.
3. Experiments based on microwave/fiber optic communication.

References:

Selected scientific papers.
Course No: EE 412  
Course Name: Communication theory II  
Credits: 4 (3-2-0)  
Course Position: Semester 7  

Course Content  
Module 1: Basics of information theory, entropy for discrete ensembles; Shannon's noiseless coding theorem; Encoding of discrete sources.  
Module 2: Markov sources; Shannon's noisy coding theorem and converse for discrete channels; Calculation of channel capacity and bounds for discrete channels; Application to continuous channels.  
Module 3: Techniques of coding and decoding; Huffman codes and uniquely detectable codes; cyclic codes, convolutional arithmetic codes.  

Text/Reference Books:  
Course No: EE 413  
Course Name: Power Electronics  
Credits: 3 (2-2-0)  
Course Position: Semester 7

Course Content

Module 1: Characteristics and switching behavior of different solid-state devices namely Power Diode, SCR, UJT, TRIAC, DIAC, GTO, MOSFET, IGBT, MCT and power transistor. Two-transistor analogy of SCR, Firing circuits of SCR and TRIAC, SCR gate characteristics,

Module 2: SCR ratings. Protection of SCR against over current, over voltage, high dV/dt, high dl/dt. Thermal protection Methods of commutation. Series and Parallel operation of SCR.

Module 3: Classification of Rectifiers, Phase controlled rectifiers: Single phase half wave controlled. Fully controlled and half controlled rectifiers and their performance parameters.

Module 4: Three phase half wave, full wave and half controlled rectifiers and their performance parameters. Effect of source impedance on the performance of single phase and three phase controlled rectifiers. Single-phase and three phase Dual Converter.

Text/Reference Books:

- M. Ramamurthy, „Thyristor and their applications”, East West Publication.
Course No: EE 415  
Course Name: Communication Networks  
Credits: 3 (2-2-0)  
Course Position: Semester 8  

Course Content  

Module 2: Analysis of packet multiplexed stream traffic; Introduction to Deterministic Network Calculus and packet scheduling algorithms and their analysis.  

Module 3: Stochastic analysis of packet multiplexed stream traffic. Overview of queueing models, Little's theorem, Brumelle's theorem, M/G/1 queue formulae, development of equivalent bandwidth of a stream source.  


Module 5: Introduction to multiple access channels. Description and analysis of the Aloha, Ethernet, and CSMA/CA protocols. Brief overview of ad hoc networks and issues in sensor networks.  

Module 6: Packet Switching and Architecture of routers and packet switches. Queueing issues in packets switches, input and output queueing, virtual-output-queueing, maximum and maximal matching algorithms, stable matching algorithm  

Texts/Reference Books:  
Department Elective Courses
Course No: EE 331
Course Name: Electronic Devices
Credits: 2 (2-0-0)
Course Position: Semester 5

Course Content
Module 1: Modeling devices: Static characteristics of ideal two terminal and three terminal devices; Small signal models of non-linear devices.

Module 2: Introduction to semiconductor equations and carrier statistics: Poisson's and continuity equations, Fermi-Dirac statistics and Boltzmann approximation to the Fermi-Dirac statistics.

Module 3: Semiconductor Diodes: Barrier formation in metal-semiconductor junctions, PN homo- and hetero- junctions; CV characteristics and dopant profiling; IV characteristics; Small signal models of diodes; Some Applications of diodes.

Module 4: Field Effect Devices: JFET/HFET, MIS structures and MOSFET operation; JFET characteristics and small signal models; MOS capacitor CV and concept of accumulation, déplétion and inversion; MOSFET characteristics and small signal models.

Module 5: Bipolar transistors: IV characteristics and elers-Moll model; small signal models; Charge storage and transient response.

Module 6: Discrete transistor amplifiers: Common emitter and common source amplifiers;Emitter and source followers.

Text/Reference Books:
- D. A. Neamen, Semiconductor Physics and Devices (IRWIN), Times Mirror High Education Group, 1997.
Course No: EE 332
Course Name: Electro mechanical energy conversions
Credits: 2 (2-0-0)
Course Position: Semester 5

Course Content

TRANSFORMERS: Basic theory, construction, operation at no-load and full-load, equivalent circuit, phasor diagram, O.C. tests for parameters determination, efficiency and regulation, auto-transformer, introduction to three-phase transformer; Scott connection, parallel operation of transformer.

UNIT – II: PRINCIPLES OF ELECTROMECHANICAL ENERGY CONVERSIONS: Force and torque in magnetic field system, energy balance, energy and force in singly excited magnetic field system, concept of co-energy, forces and torques is system with permanent magnets, dynamic equation.

DC MACHINES: Basic theory of DC generator, brief idea of construction, emf equation, load characteristics, basic theory of DC motor, concept of back emf, torque and power equations, load characteristics, starting and speed control of DC motors, Types of DC generator & motors Armature reaction, communication, characteristics of DC machines.

UNIT – III: INDUCTION MOTOR: Basic theory, construction, Phasor diagram, advantage of IM over other conventional machines Equivalent circuit, Torque equation, Load characteristics, starting speed control of induction motor, Introduction to single phase Induction motor double field revolving theory, types of single phase IM and its applications, open circuit & block rotor test.


Text Book:
- Electrical Machines: P.S. Bimbhra; Khanna

Reference:
- Electrical Machines: Nagarath and Kothari; TMH
- Electrical Machines: Mukherjee and Chakravorti; Dhanpat Rai & Sons.
- Electrical Technology (Vol-II): B.L. Theraja; S. Chand.
Course No: EE 334  
Course Name: Advanced Power Systems  
Credits: 3 (2-2-0)  
Course Position: Semester 6  

Course Content  
Module1: Introduction- Structure of power systems, Power system control centre and real time computer control, SCADA system Level decomposition in power system Power system security  
Module2: Various operational stages of power system Power system voltage stability, Deregulation and electricity market  
Module3: Economic Operation : Concept and problems of unit commitment Input-output characteristics of thermal and hydro-plants System constraints Optimal operation of thermal units without and with transmission losses, Penalty factor, incremental transmission loss, transmission loss formula (without derivation)  
Module4: Hydrothermal scheduling long and short terms Concept of optimal power flow  
Module5: Load Frequency Control : Concept of load frequency control, Load frequency control of single area system: Turbine speed governing system and modelling, block diagram representation of single area system, steady state analysis, dynamic response, control area concept, P-I control, load frequency control and economic dispatch control. Load frequency control of two area system:  
Module6: Tie line power modelling, block diagram representation of two area system, static and dynamic response  
Module7: Automatic Voltage Control : Schematic diagram and block diagram representation, different types of Excitation systems & their controllers.  

Text/Reference Books:  
- J. Wood & B.F. Wollenburg,“ Power Generation, Operation and Control “ John Wiley  
• M.H. Rashid, “Power Electronics: Circuits, devices and Applications” PHI
• T. K. Nagsarkar & M.S.Sukhiza, “ Power System Analysis” Oxford University Press.
Course No: EE 435  
Course Name: VLSI Design  
Credits: 3 (2-2-0)  
Course Position: Semester 7

Course Content
Module 1: Review of digital design (8 lectures)- MUX based digital design (1), Design using ROM, Programmable Logic Arrays (PLA) and Programmable Array Logic (PAL) (2), Sequential circuits and timing - Setup and hold times (1), Sequential circuit design - design of Moore and Mealy circuits (2), Design of a pattern sequence detector using MUX, ROM and PAL (1), and Design of a vending machine controller using PAL (1).

Module 2: Introduction to Verilog coding (6 lectures)- Introduction to Verilog (1), Realization of Combinational and sequential circuits (2), RTL coding guidelines (1), Coding organization and writing a test bench (2).

Module 3: Simulation, Synthesis, Place and Route, and Back Annotation (12 lectures)- Design flow (1), Simulation using Modelsim (4), Synthesis using Synplify (4), Place and Route, and Back Annotation using Xilinx (3)

Module 4: Design using Algorithmic State Machine Charts (7 lectures)- Derivation of ASM charts (1), Design examples such as dice game, etc. using ASM charts (3), Implementation of ASM charts using microprogramming (2), and Verilog design of bus arbitrator (1)

Module 5: Design of memories (3 lectures)- Verilog realization of Read Only Memory (ROM) (1), Verilog realization of Random Access Memory (RAM), and Verilog coding of controller for accessing external memory (2).

Module 6: Design of Arithmetic functions (5 lectures)- Pipelining concept, Verilog design of a pipelined adder/subtractor (1), Design of Multipliers (3), and Verilog design of a pipelined multiplier (1).

Module 7: Design for testability (3 lectures)- Testing combinational and sequential logic (1), Boundary scan testing, and Built-in self test (2).

Module 8: Design Applications (4 lectures)- Design of a traffic light controller using Verilog (1), and Design of discrete cosine transform and quantization processor for vidéo compression using Verilog (3).

Module 9: Hardware implementation using FPGA board (2 lectures)- Features of FPGA board and demonstration of traffic light controller design (1), and Universal, asynchronous, receiver-transmitter design using FPGA board (1).

Text/Reference Books:
- L. Glaser and D. Dobberpuhl, The Design and Analysis of VLSI Circuits, Addison Wesley, 1985
MAHINDRA ÉCOLE CENTRALE

Course No: EE 438
Course Name: Transmission & distribution
Credits: 4 (3-2-0)
Course Position: Semester 8

Course Content
Module 1: Generation of Electric Power- Brief description of Thermal, hydro nuclear and gas power plants & other non-conventional power plants.

Module 2: Transmission and Distribution Systems- DC 2–wire and 3 – wire systems, AC single phase, three phase and 4-wire systems, comparison of copper efficiency. Distribution Systems: primary and secondary distribution systems, concentrated & uniformly distributed loads on distributors fed at one and both ends, ring distribution, sub mains and tapered mains, voltage drop and power loss calculations, voltage regulators.

Module 3: Overhead Transmission Lines- Types of Conductors, Line parameters; calculation of inductance and capacitance of single and double circuit transmission lines, three phase lines with stranded and bundle conductors, Generalized ABCD constants and equivalent circuits of short, medium & long lines. Line Performance: regulation and efficiency of short, medium and long lines, Series and shunt compensation, Introduction to FACTS.

Module 4: Overhead Line Insulators- Type, string efficiency, voltage distribution in string of suspended insulators, grading ring, preventive maintenance.

Module 5: Mechanical Design of Transmission Lines- Different types of tower, sag-tension calculations, sag-template, string charts, vibrations & damaging Corona-corona losses, radio & audio noise, transmission line – communication line interference.

Module 6: Tariffs & Load Curves- Definition & different tariffs for domestic, commercial, industrial application, Different Load and Load duration curves. Curves their significance.

Module 7: Introduction to EHV/HVDC transmission- Brief description of both the systems with working & constructional details.

Text/Reference Books:
- Burke James, J., “Power Distribution Engineering; Fundamentals and Applications” Marcel Dekker 1996.
Course No: EE 441
Course Name: Instrumentation
Credits: 4 (3-2-0)
Course Position: Semester 8

Course Content

Module 2: Virtual Instrumentation: Introduction to graphical programming, data flow & graphical programming techniques, advantage of VI techniques, VIs and sub-VIs loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, string and file I/O, Code Interface Nodes and DLL links.

Module 3: Data Acquisition Methods: Analog and Digital IO, Counters, Timers, basic ADC designs, interfacing methods of DAQ hardware, software structure, use of simple and intermediate VIs. Use of Data Sockets for Networked Communication and Controls.

Module 4: PC Hardware Review & Instrumentation Buses: Structure, timing, interrupts, DMA, operating system, ISA, PCI, USB, PCMCIA buses. IEEE488.1 & 488.2 Serial Interfacing - RS232C, RS422, RS423, RS485; USB, VXI, SCXI, PXI.

Text/Reference Books:
- S. Gupta, J.P. Gupta, „PC interfacing for Data Acquisition & Process Control”, ISA,
Course No: EE 442
Course Name: Mobile Communication and Networks
Credits: 4 (3-2-0)
Course Position: Semester 8

Course Content
Module 1: Cellular concepts- Cell structure, frequency reuse, cell splitting, channel assignment, handoff, interference, capacity, power control; Wireless Standards: Overview of 2G and 3G cellular standards.

Module 2: Signal propagation- Propagation mechanism- reflection, refraction, diffraction and scattering, large scale signal propagation and lognormal shadowing. Fading channels- Multipath and small scale fading- Doppler shift, statistical multipath channel models, narrowband and wideband fading models, power delay profile, average and rms delay spread, coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading, average fade duration and level crossing rate.


Module 4: Multiple access schemes- FDMA, TDMA, CDMA and SDMA. Modulation schemes- BPSK, QPSK and variants, QAM, MSK and GMSK, multicarrier modulation, OFDM.

Module 5: Receiver structure- Diversity receivers- selection and MRC receivers, RAKE receiver, equalization: linear-ZFE and adaptive, DFE. Transmit diversity-Alamouti scheme.

Module 6: MIMO and space time signal processing, spatial multiplexing, diversity/ multiplexing tradeoff.

Module 7: Performance measures- Outage, average snr, average symbol/bit error rate.

Module 8: System examples- GSM, EDGE, GPRS, IS-95, CDMA 2000 and WCDMA.

Text/Reference Books:
Course No: EE 443
Course Name: Artificial Intelligence and Robotics
Credits: 4 (3-2-0)
Course Position: Semester 8

Course Content:

Module 1: Scope of AI - Games, theorem proving, natural language processing, vision and speech processing, robotics, expert systems, AI techniques- search knowledge, abstraction.

Module 2: Problem solving - State space search; Production systems, search space control: depth-first, breadth-first search, heuristic search - Hill climbing, best-first search, branch and bound. Problem Reduction, Constraint Satisfaction End, Means-End Analysis


Text Books:
- Robin R Murphy, Introduction to AI Robotics PHI Publication, 2000

Reference Books:
Open Elective Courses
Course No: HS 409
Course Name: Philosophy of Science
Credits: 1.5 (1-1-0)
Course Position: Semester 5

Objectives:
This course aims to undertake and indulge in a philosophical questioning and reflection of the most contemporary knowledge, notably stemming from physics. An important place and prominence is devoted to the problem of time.

On completion of the course, students should be able to
The fundamental purpose is to open and broaden students’ mind by presenting to them and acquainting them with the scientific knowledge obtained throughout the twentieth century and by urging them to reflect on its implications.

Course Content:
During the first session of the lecture series the students will be required to vote (by a simple show of hands) in order to select five themes and topics from a list of a dozen offered.

- first day: The question of time
- 2nd day: The question of time (following-on sequence)
- 3rd day: From where does the effectiveness of mathematics stem in physics?
- 4th day: Science and ethics
- 5th day: Einstein

Text Book:
A copious and rich bibliography is given.

References
Objectives:

This course is an introduction to the sociology of organizations. This part of sociology studies individual and collective behaviour within established human groups called organizations. This module is not a management course, but rather a course on management. It offers theoretical bases and methodology in organization sociology for their application to real problem-solving cases. It also helps understand dysfunctions and deviance phenomena in organizations. The course focuses on the strategic and systemic analysis of organizations to help students develop a thought process that includes complexity and the dimension of power. Power relations are considered as relations of cooperation, negotiation, arrangement, and not as relations of imposed authority. Examples and practical cases will be considered in various areas (companies, industry, education, institutions) to help facilitate the implementation of the proposed concepts and methods.

Course Content:

- Introduction to sociology: the field of sociology, history, concepts, and methods
- Sociology of organizations
- Organization: definitions, questions
- Rationalist approach: the scientific organization of work (F.W. Taylor)
- Human relationships approach (E. Mayo)
- Strategic and systematic approach (M. Crozier): notions of power, stakes, strategy, uncertainty zones, systems of concrete actions
- The practice of strategic and systematic analysis: principles, tools, and methods
- Dysfunction, deviance, accident in organizations
- Change in organizations

Text Book:

Articles and Instructor Notes.

References:

- Sociology
Course No: CB 404
Course Name: Chemical and Bio Engineering
Credits: 3 (2-2-0)
Course Position: Semester 5

Objectives:
This course is a general introduction to the techniques and methods employed in Chemical Engineering. It will allow students to acquire skills that are easily transposable to a number of other fields of engineering. One of the main objectives of Chemical Engineering is to design, implement and optimize environmentally friendly processes for use in the manufacture of an extensive range of products in many areas including the pharmaceutical, petrochemical, fine chemical, food, cosmetics, water and waste treatment, high-tech, biotechnology and traditional industries. Many techniques and processes are widely used in the recycling and recovery of materials and the treatment of liquid and gas effluents, thus making them powerful allies of sustainable development.

Course Content:
- Lecture: introduction, flow models, mass and energy balance
- Case study: production of bio ethanol
- Lecture: perfectly stirred reactors (1)
- Case study: production of an active pharmaceutical principle
- Lecture: perfectly stirred reactors (2)
- Case study: design of industrial wastewater treatment reactors
- Lecture: pluflow reactor
- Case study: production of styrene
- Lecture: liquid-vapour equilibria, single-stage distillation
- Case study: seawater desalination
- Lecture: multi-stage distillation with constant molar fluxes
- Case study: production of bio ethanol
- Lecture: multi-stage distillation
- Case study: ammonia recycling in the fabrication process of solar panels
- Lecture: basis of mass transfer
- Case study: modelling of in vitro and in vivo treatments of oral intoxications
- Lecture: mass transfer
- Case study: design of a purification unit for polluted air
- Lecture: electrochemistry, electrochemical processes
- Case study: design of a fuel cell for a car.
- Lecture: membrane processes
- Case study: design of a membrane bioreactor for industrial waste treatment

Text Book:
Objectives: This course aims at providing knowledge essential for the students in their future careers as engineers. It is built from the two cornerstone stones of modern physics: quantum physics and statistical physics.

Quantum physics essentially describes the behavior of objects at the atomic scale;

Statistical physics provides the link from the microscopic to the macroscopic scale. It describes the behavior of large populations of identical particles. It links the microscopic properties that have a quantum nature with classical or macroscopic properties such as magnetization, temperature, heat capacity and other thermodynamic quantities.

The first half of the course is devoted to an introduction to quantum physics and the study of basic examples (e.g. the hydrogen atom and the harmonic oscillator). Most of the second half of the course is dedicated to the basics of statistical physics. The course ends with applications to solids, gases and a brief introduction to nuclear physics.

Course Content:

- Birth of a new physical theory
- Quantum wave physics
- Quantum formalism
- Time evolution
- Harmonic oscillators
- Angular momentum and spin
- From hydrogenoid atoms to the atom
- Conferences
- Methods of approximation
- Ensembles of particles, microcanonical and canonical statistical treatment
- Quantum statistics and classical limit
- Ideal gases of fermions, the Sommerfeld metal
- Basics of nuclear physics

Text Book:

- Fundamentals of statistical and thermal physics, F. Reif, McGraw-Hill, 1965
References:

- Quantum mechanics (2 vol) Cohen Tanoudji, Diu Laloé
- Quantics: Rudiments of Quantum Physics, Francoise Balibar, Jean Marc Levy-Leblond
- Statistical Physics, Gregory H. Wannier
Mandatory Courses
Course No: HS 102
Course Name: French Language and Culture
Credits: no credit (0-2-0)
Course Position: Semester 1

Objectives:

- Student should be able to understand and practice basic French at A1 level (see Common European Framework Reference for Languages), basic user level, breakthrough or beginner.
- He/she can understand and use everyday expressions and basic phrases about things he/she has or knows well
- Can introduce him/herself and familiar people and answer questions about personal details
- Can interact in a simple way when he/she is prepared.

Course Content:
Student learns on authentic documents: media, radio, and video. He/she studies French language and discovers French culture: economy, politics, tradition, philosophy

Text Book:

References:
- ECHO A1 FROM CLE INTERNATIONAL PUBLISHERS

LABORATORY WORK

Course Content:
- Pedagogical activities which include role plays, simulations, phonetic workshops, games, excerpts of movies, songs for language learning purposes to make the language process interactive and build the four main competencies: comprehension, listening, reading and writing.

Text Books:
- ECHO A1 FROM CLE INTERNATIONAL PUBLISHERS
Course No: HS 104  
Course Name: French Language and Culture  
Credits: no credit (0-2-0)  
Course Position: Semester 2  

Objectives:  
Student should be able to understand and practice basic French at A1 level (see Common European Framework Reference for Languages), basic user level, breakthrough or beginner.  
He/she can understand and use everyday expressions and basic phrases about things he/she has or knows well  
He/she can introduce him/herself and familiar people and answer questions about personal details  
He/she can interact in a simple way when he/she is prepared.  

Course Content:  
Student learns on authentic documents: media, radio, video. He/she studies French language and discovers French culture: economy, politics, tradition, philosophy.  

Text Book:  

References:  
- ECHO A1 FROM CLE INTERNATIONAL PUBLISHERS  

LABORATORY WORK  

Course Content:  
- Pedagogical activities which include role plays, simulations, phonetic workshops, games, excerpts of movies, songs for language learning purposes to make the language process interactive and build the four main competencies; comprehension, listening, reading and writing.  

Text Books:  
- ECHO A1 FROM CLE INTERNATIONAL PUBLISHERS
Course No: HS 206
Course Name: French Language and Culture
Credits: no credit (0-2-0)
Course Position: Semester 3

Objectives:
Student should be able to understand and practice basic French at way stage or elementary levels (DEFT A1-A2).
Student can understand frequently used expressions and sentences related to familiar things, events, people (e.g. family information, school)
He/she can communicate in simple tasks and simple exchanges of information on familiar matters
He/she can describe immediate environment, leisure, needs.

Course Content:
Student learns on authentic documents: media, radio, video. He/she studies French language and discovers French culture: economy, politics, tradition, philosophy.

Text Books:
- Alter ego, Hachette education, 2006

References
- ECHO A1 FROM CLE INTERNATIONAL PUBLISHERS

LABORATORY WORK

Objective:

Course Content:
- Pedagogical activities which include role plays, simulations, phonetic workshops, games, excerpts of movies, songs for language learning purposes to make the language process interactive and build the four main competencies; comprehension, listening, reading and writing.
Course No: HS 208  
Course Name: French Language and Culture  
Credits: no credit (0-2-0)  
Course Position: Semester 4  

Objectives:

Student should be able to understand and practice basic French at way stage or elementary levels (DEFT A1-A2).

Student can understand frequently used expressions and sentences related to familiar things, events, people (e.g. family information, school)

He/she can communicate in simple tasks and simple exchanges of information on familiar matters

He/she can describe immediate environment, leisure, needs.

Course Content:

Student learns on authentic documents: media, radio, video. He/she studies French language and discovers French culture: economy, politics, tradition, philosophy.

Text Books:

- Alter ego, Hachette education, 2006

References

- ECHO A1 FROM CLE INTERNATIONAL PUBLISHERS

LABORATORY WORK

Objective:

Course Content:

- Pedagogical activities which include role plays, simulations, phonetic workshops, games, excerpts of movies, songs for language learning purposes to make the language process interactive and build the four main competencies: comprehension, listening, reading and writing.

Text Books:

- ECHO A1 FROM CLE INTERNATIONAL PUBLISHERS
Course No: HS 310
Course Name: French Language and Culture
Credits: no credit (0-2-0)
Course Position: Semester 5

Objectives:
Student should be able to understand and practice basic French at threshold or intermediate level (DELF A2-B1),
Student can understand points of standard input on familiar matters (e.g. work, leisure) and can explain his/her point of view:

- He/she can produce simple text on familiar topics or personal interest
- He/she can describe experiences and ambitions
- He/she can give reasons and explanations for opinions and plans.

Course Content:
Student learns on authentic documents: media, radio, video. He/she studies French language and discovers French culture: economy, politics, tradition, philosophy.

Text Book:

References
- ECHO A1 FROM CLE INTERNATIONAL PUBLISHERS

LABORATORY WORK

Course Content:
- Pedagogical activities which include role plays, simulations, phonetic workshops, games, excerpts of movies, songs for language learning purposes to make the language process interactive and build the four main competencies; comprehension, listening, reading and writing.

Text Books:
- ECHO A1 FROM CLE INTERNATIONAL PUBLISHERS
Course No: HS 312
Course Name: French Language and Culture
Credits: no credit (0-2-0)
Course Position: Semester 6

Objectives:
Student should be able to understand and practice basic French at threshold or intermediate level (DELF A2-B1),

Student can understand points of standard input on familiar matters (e.g. work, leisure) and can explain his/her point of view:

- He/she can produce simple text on familiar topics or personal interest
- He/she can describe experiences and ambitions
- He/she can give reasons and explanations for opinions and plans.

Course Content:
Student learns on authentic documents: media, radio, video. He/she studies French language and discovers French culture: economy, politics, tradition, philosophy.

Text Book:

References:
- ECHO A1 FROM CLE INTERNATIONAL PUBLISHERS

LABORATORY WORK

Course Content:
- Pedagogical activities which include role plays, simulations, phonetic workshops, games, excerpts of movies, songs for language learning purposes to make the language process interactive and build the four main competencies; comprehension, listening, reading and writing.

Text Books:
- ECHO A1 FROM CLE INTERNATIONAL PUBLISHERS