OUR MISSION

To provide value-based technical education and mould the character of the younger generation through a synthesis of science and spirituality so that their earnest endeavour to achieve progress and prosperity in life is matched by an ardent desire to extend selfless service to the society, one complementing the other.

AMRITA VISHWA Vidyapeetham (UNIVERSITY)
Established under Section 3 of the UGC Act 1956
Coimbatore - 641 105.

Integrated Master of Science
(Mathematics/Physics)

Regulations, Curricula and Syllabi
(for the students admitted from the year 2009 onwards)

AMRITA SCHOOLS OF ARTS AND SCIENCES

AMRITAPURI - KOCHI - MYSURU
REGULATIONS FOR THE
Integrated M Sc (Mathematics/Physics) DEGREE PROGRAMME

1. Dr. V Krishna Kumar,
   Principal, Amrita School of Arts and Sciences, Amritapuri - CHAIRMAN

2. Dr. C. S. Shastry,
   Professor and Chairperson, Dept. of Sciences,
   Amrita School of Engineering, Coimbatore.

3. Dr. R. V. Ushakumari,
   Assoc. Prof. and Chairperson, Dept. of Mathematics,
   Amrita School of Arts and Sciences, Amritapuri.

4. Dr. K. B. Srikanth,
   Assoc. Prof. and Chairperson, Dept. of Physics,
   Amrita School of Arts and Sciences, Amritapuri.

5. Dr. Ramaiah Kambliyil,
   Assoc. Prof., Dept. of Physics,
   Amrita School of Arts and Sciences, Amritapuri.

6. Dr. K. Suma Sundaram,
   Assoc. Prof., Dept. of Mathematics,
   Amrita School of Engineering, Coimbatore.

7. Dr. V. M. Nambudiripad,
   Professor, Indian Institute for Science Education and Research, Trivandrum - EXTERNAL EXPERT

8. Dr. T.R. Ramakrishna,
   (Tit. Prof., National Institute of Technology, Calicut), Kochi - EXTERNAL EXPERT

9. Dr. K. Neelakanda,
   (Tit. Prof., Univ. of Calicut), Kochi - EXTERNAL EXPERT


general

R.1 Admissions
R.2 Language of Instruction
R.3 Structure of the Programme
R.4 Tuition Fees
R.5 Faculty Advisor
R.6 Course Committee
R.7 Class Committee
R.8 Pre-registration and Registration
R.9 Dropping Courses
R.10 Vacation Courses
R.11 Re-appearance Examinations
R.12 Contact Courses
R.13 Eligibility to continue
R.14 Maximum duration
R.15 Attendance
R.16 Assessment Procedure
REGULATIONS

R.17 Second-chance Examination

R.18 Grading

R.19 Declaration of Result

R.20 Re-check/Revaluation of answer papers

R.21 Course Repetition

R.22 Semester Grade Point Average

R.23 Cumulative Grade Point Average

R.24 Grade Card

R.25 Transcript

R.26 Discipline

R.27 Redress of grievances

R.28 Award of the Degree

R.29 Interpretation Clause

R.30 Amendment to Regulations

GENERAL

1. Candidates who have passed the final examination under the 10+2 system or its equivalent with a minimum of 50% of marks in aggregate and with Mathematics and Physics as subjects, are eligible to apply for admission to the Integrated M Sc degree programme. However, the eligibility criterion is subject to modification, as per the directives of competent authorities.

2. Procedure for admission will be decided from time to time by the University in accordance with the guidelines from competent authorities.

3. The duration of the Programme will normally be ten semesters, spread over five academic years.

4. The award of the Integrated M Sc degree will be recommended by the Academic Council and approved by the Board of Management in accordance with the regulations of the University.

5. Notwithstanding anything stated above, the Amrita Vishwa Vidyapeetham reserves the right to modify any of the ordinances, as deemed fit, from time to time.

R.1 Admissions

R.1.1 The admission to the programme will be as per the ordinances and regulations of the University.

R.1.2 The intake to each school will be decided by the University from time to time.

R.1.3 Transfer of students from one campus to another is generally not permitted. However, based on the availability of vacancy in the discipline and the academic merit of the student, special cases may be allowed in the beginning of the third semester, on the mutual consent of the Heads of both the Departments and Schools and with the approval of the University. The decision of the University will be final in this matter.

R.2 Language of Instruction

The language of instruction will ordinarily be English, for all courses.
R.3 Structure of the Programme

R.3.1 The Programme will be structured on a credit based system and continuous evaluation, following semester pattern.

R.3.2 The programme consists of the following:
(a) Core courses in the primary area of the programme, including seminars, projects, etc.
(b) Allied courses
(c) Elective courses
(d) Humanities and General Studies (like Environmental Sciences, Languages and Cultural Education, etc.)

Additionally, soft skill training and some social interaction/social work, which may be part of Cultural Education may also be insisted upon.

R.3.3 The curriculum of the Integrated M Sc degree programme will have credits, apportioned in the following knowledge segments:
   Core subjects (incl. Electives)
   Allied subjects (incl. Electives)
   Humanities and General Studies

R.3.4 Credits are assigned to the courses based on the following general pattern
   One credit for each lecture period per week
   One credit for each tutorial period per week
   One credit for each laboratory course/practical of two/three periods per week

R.3.5 The Integrated M Sc degree programme shall have a curriculum, as prescribed.

R.3.6 The curriculum and the syllabi may be updated from time to time by the Academic Council.

R.3.7 Core, allied, elective: Certain courses in each knowledge segment are identified as Core courses, certain others as allied courses and few others as electives.

There is mandatory registration and credit earnings requirement for core courses. While it is mandatory to register for all the allied courses, failure to earn credit at these does not necessarily mean repeating the courses. Often another course may be permitted as replacement course. Electives are free to be chosen from those offered.

R.4 Tuition Fees
At the beginning of each academic year, students shall pay all the fees prescribed. A student who drops out of the programme whose registration is cancelled due to any reason, cannot claim refund of any fees paid.

R.5 Faculty Advisor
In order to (i) guide the students in planning their courses of study (ii) advise them on academic programmes and (iii) monitor their progress, the departments will assign a certain number of students to a faculty member, who will be designated as their Faculty Advisor.

R.6 Course Committee
The programme in all the campuses will be governed by the same curricula and syllabi. Course committees are constituted for running each course in all the campuses at the same time and shall be common for all the campuses. The committee for each course shall comprise of mentors from each campus offering the program.

The course committee shall interact at the beginning of the semester to finalize teaching programme as well as evaluation pattern, and during the middle of the semester to finalize the Question papers and keys for the end-semester examination.

The mentor in each campus will coordinate all aspects of teaching of the course in the respective campus, by convening meetings of all teachers handling the course.

R.7 Class Committee
R.7.1 Each “semester” class of students of the programme will have a class committee, in each School, in a campus. Thus, there will be a class committee for, say, the first semester Integrated M Sc, another for the third semester Integrated M Sc, etc.

R.7.2 The Class Committee shall be constituted by the Chairperson of the department.
The constitution of the class committee will be as follows:
a) The convener of the class committee who is a faculty member who...
may not be handling any course for the class concerned, nominated by chairperson of the department, 
b) All the teachers handling courses for the class,  
c) The faculty advisor of the class,  
d) Two student representatives nominated by the Chairperson of the department.  
The chairperson of the department may attend the committee meetings as a special invitee.

R.7.3 The class committee shall meet at least thrice in a semester. The student representatives will attend only those class committee meetings, for which they are invited.

R.7.4 The class committee shall meet at the beginning of the semester to finalise the academic programme as well as evaluation pattern. At the end of the semester the committee (without student representatives) will meet to finalise the results.

R.8 Pre-registration and Registration
R.8.1 Every student shall register for the courses which he/she wishes to undergo during a semester.

R.8.2 Except for the first semester, pre-registration for a semester will be done during a specified week before the end semester examination of the previous semester. The consent of the faculty advisor is mandatory before pre-registering for every course. Additionally, the consent of the teacher is also necessary.

R.8.3 From the second semester onwards, all students have to register at the beginning of a semester. Registration will be open for the first two days of the semester. A student will be eligible to register only if he/she satisfies the condition R.13. (given later in this document) and will be permitted to register only if he/she has cleared all the dues to the Institution, hostel, library etc., at the time of registration and if he is not debarred from registration as part of any disciplinary action of the Institution.

R.8.4 At the time of registration, a student can drop a course registered earlier or substitute a course by another for valid reasons, with the consent of the faculty advisor.

R.9 Dropping Courses
The curriculums for any semester except for the final semester will have normally around 24 credits. If a student finds his/her load heavy in any semester, or for any other valid reasons, he/she may drop courses without any academic penalty within three weeks of the commencement of the semester, but before commencement of the first periodical test, with the written approval of his/her faculty advisor and Chairperson of the Department. However, the student should ensure that the credits registered in any semester should enable him/her to earn the minimum number of credits specified in R.13.

Withdrawal from one or more courses after the specified date will entail academic penalties in the form of a ‘Failed', due to lack of attendance', "FA" grade appearing on the grade card.

R.10 Vacation Courses
Vacation courses may be offered by a department with the approval of the Principal concerned, according to requirements and as per rules framed for the purpose.

R.11 Re-appearance Examinations (Re-evaluation of courses)
Students who have failed to earn credits for a course even after two registrations, can register for re-evaluation of the course, on payment of a prescribed fee. Re-evaluation is a provision for the student to earn credits for the course, by appearing for the examinations (without attending classes) in that course, whenever held. Re-evaluation can be done either for both internal assessment and end semester examinations or only for the end-semester examinations.
Effective from 2010 admissions:
Students securing an ‘F’ grade, in a theory-based course and earning 40% of marks or more, in the Internal Assessment component of evaluation, shall be eligible to re-appear directly for the end-semester examination, in that course, whenever held. This shall be applicable only up to the sixth semester of the programme.

R.12 Contact Courses
A contact course may be offered during the regular semester or summer term by a department, as per rules to a final year student who has obtained ‘F’ grade in one or two course(s). The course(s) will be offered only on the recommendation of the department which offered the course(s) and with the approval of the Principal concerned.

R.13 Eligibility to continue the Programme
R.13.1 A student has to earn a minimum of 10 credits in the first semester to continue in the second semester. However, under special circumstances a student who fails to earn 10 credits in the first semester may be allowed to continue in the second semester with a severe warning, as per the rules framed for the purpose.

R.13.2 At the end of the second semester the student should have earned 22 credits cumulatively (including vacation course, if any) to continue in the third semester.

R.13.3 From the beginning of the fourth semester onwards, a student must have earned the minimum number of cumulative credits, as mentioned below, to be eligible to move to the higher semester –

<table>
<thead>
<tr>
<th>Semester</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV</td>
<td>35</td>
</tr>
<tr>
<td>V</td>
<td>50</td>
</tr>
<tr>
<td>VI</td>
<td>67</td>
</tr>
<tr>
<td>VII</td>
<td>90</td>
</tr>
<tr>
<td>VIII</td>
<td>110</td>
</tr>
<tr>
<td>IX</td>
<td>132</td>
</tr>
<tr>
<td>X</td>
<td>156</td>
</tr>
</tbody>
</table>

Eligibility to continue (effective from 2010 admissions):
At the beginning of second to sixth semester, a student shall have not more than five arrear courses (excluding Lab. courses, Courses in Cultural Education and Soft Skills). Those who have more than five arrear courses, at the beginning of the semester (till the sixth semester), shall register for all the available arrear courses of earlier semesters and then register, if possible, for courses of the higher semester, subject to a maximum of 28 credits.

However, from the seventh semester onwards, a student shall have not more than three arrear courses (excluding Lab. courses and Courses in Cultural Education). Those who have more than three arrear courses, at the beginning of the VII, VIII, IX or X semesters, shall register for all the available arrear courses of earlier semesters and then register, if possible, for courses of the higher semester, subject to a maximum of 28 credits.

R.14 Maximum Duration of the Programme
R.14.1 A student is expected to complete the programme in sixteen semesters. However, a student may complete the Integrated M Sc degree programme at a slow pace within sixteen semesters, with the prior permission of his/her Faculty Advisor and Chairperson of the Department, but he/she has to satisfy the condition stipulated in R.13.

R.14.2 A student may be permitted by the Principal concerned to withdraw from the programme for a semester or a longer period for reasons of ill health or on other valid grounds. In such cases the maximum duration of the programme will be extended and ratified by the Academic Council.

R.14.3 EXIT OPTION
R.14.3.1 Candidates who desire to exit the programme at the end of the sixth semester, may do so on specific request to the concerned Head of the Institution.

R.14.3.2 Such students shall undertake a 6-credit (10-credit for 2010 batch onwards) Project, during the summer term, in the third year of their programme.

R.14.3.3 These students shall need to complete all the credit requirements prescribed up to the end of VI semester, within a maximum period of ten semesters.

R.14.3.4 Such students shall be eligible for the award of the B Sc (Mathematics/Physics—dual major) degree and shall be eligible for classification, but not eligible for any ranking.
R.15 Attendance
R.15.1 Attendance of the students will be marked by the teacher during every period of a course.
R.15.2 Every student, registered for a course, is expected to attend 100% of the classes conducted for the course. A minimum attendance of 80% of all the classes engaged is essential before the student is permitted to write the end semester examination of the concerned course(s).
R.15.3 Leave of absence on genuine grounds can be permitted up to a maximum of 20% provided the leave is applied for in time, and sanctioned (either in advance, or immediately after the period of absence, according to the merits of the case). Unauthorized absence will be treated as breach of discipline.

In the case of illness, leave must be applied for, supported by a proper medical certificate and recommended by the Medical Officer attached to the School.

If the student is away to represent the University in sports, games, technical seminar, etc., he/she can be considered to be “on other duty”. “Duty leave” for these days can be granted and generally for not more than five days in a semester.
R.15.4 Finalization of attendance for every course shall be done five working days before the last instruction day of the semester. Any student failing to secure a minimum of 80% attendance in a course will not be eligible to appear for the end semester examination in that course.

If the attendance of a student falls short of 80% in any course, due to continuous absence caused by accident, prolonged illness, or unforeseen circumstances, such case may be considered by the Principal concerned for condonation of absence based on the request of the student supported by recommendation of the class advisor and chairperson of the department concerned.
R.15.5 In the case a student who is not permitted to attend the end semester examination in any course due to lack of attendance he/she will be awarded ‘FAIL’ grade in that course, indicating ‘failure due to insufficient attendance’ and mentioned in the grade card.

R.16 Assessment Procedure
R.16.1 The academic performance of each student in each course will be assessed on the basis of continuous assessment and an end semester examination.
R.16.2 In theory courses (that are taught primarily in the lecture mode), the weightage for the continuous assessment and end semester examination will be 60:40. The continuous assessment in theory courses shall consist of at least two periodical tests, other quizzes, assignments, tutorials, viva voce etc. The weightage for these components will be decided by the course committee at the beginning of the semester. There will be one end semester examination of three hours duration in each lecture-based subject.

Effective from 2010 admissions-
The weightage for the Internal Assessment components, for theory-based courses, shall be 20 marks each, for the two periodical tests and 20 marks for the continuous assessment component, comprising of quizzes, assignments, tutorials, viva-voce, etc.
R.16.3 In the case of laboratory courses and practicals, the weightages for continuous assessment and end semester examination will be 80:20. The weightage for the components of continuous assessment will be decided by the course committee at the beginning of the course.
R.16.4 It is mandatory that the students shall appear for the end-semester examination for completion of the course.
R.16.5 If a student does not appear for any of the tests, he is not eligible to appear for the end semester examination and has to re-register for the course when offered next.
R.16.6 It is mandatory for the students to appear for the end-semester examination/Second-chance examination for completion of the course.
R.16.7 The continuous assessment of project work will be carried out as decided by the course committee. At the completion of the project work, the student will submit a bound volume of the project report in the prescribed format. The project work will be evaluated by a team of duly appointed examiners.
R.16.8 The final evaluation will be based on the content of the report,
presentation by student and a viva-voce examination on the project.
There will be 40% weightage for continuous assessment and the
remaining 60% for final evaluation.

R.16.9 If the project work is not satisfactory he/she will be asked to continue
the project work and appear for assessment later.

R.17 Second-chance Examination (Supplementary Examinations)
R.17.1 A student who happens to be absent in the end semester examination
will be awarded 'I' grade in the course (indicating incomplete). Those
having I grade will be required with prior permission to appear for
the second-chance examination for the examination. Second-chance
examination will be conducted within a fortnight after publishing the
results, as per the rules framed for the purpose.

R.17.2 The permission to appear for the second-chance examination will be
granted under valid reason by the Principal concerned, on
recommendation by the chairperson of the Department.

R.17.3 A student who secured 'F' grade will also be allowed to appear for
second-chance examination as per the rules.

R.18 Grading
R.18.1 Based on the performance in each course, a student is awarded a
grade at the end of the semester a letter grade in each of the courses registered
for. The letter grades, the corresponding grade points and the ratings
are as follows:

<table>
<thead>
<tr>
<th>Letter Grade</th>
<th>Grade Points</th>
<th>Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>A+</td>
<td>10.00</td>
<td>Exceptional</td>
</tr>
<tr>
<td>A</td>
<td>10.00</td>
<td>Outstanding</td>
</tr>
<tr>
<td>A-</td>
<td>9.00</td>
<td>Excellent</td>
</tr>
<tr>
<td>B+</td>
<td>8.00</td>
<td>Very Good</td>
</tr>
<tr>
<td>B</td>
<td>7.50</td>
<td>Good</td>
</tr>
<tr>
<td>B-</td>
<td>7.00</td>
<td>Fair</td>
</tr>
<tr>
<td>C+</td>
<td>6.50</td>
<td>Above Average</td>
</tr>
<tr>
<td>C</td>
<td>6.00</td>
<td>Average</td>
</tr>
<tr>
<td>C-</td>
<td>5.50</td>
<td>Adequate</td>
</tr>
<tr>
<td>D</td>
<td>5.00</td>
<td>Marginal</td>
</tr>
<tr>
<td>F</td>
<td>0.00</td>
<td>Failed</td>
</tr>
<tr>
<td>FA</td>
<td>0.00</td>
<td>Failure due to lack of attendance</td>
</tr>
<tr>
<td>I</td>
<td>0.00</td>
<td>Incomplete</td>
</tr>
<tr>
<td>W</td>
<td>0.00</td>
<td>Withheld</td>
</tr>
</tbody>
</table>

R.18.2 Letter grades will be awarded by the Class Committee in its final
sitting, without the student representatives.

R.18.3 A student is considered to have successfully completed the course
and earned the credit if he/she scores a letter grade "D" or better in
that course.

R.19 Declaration of Result
R.19.1 After finalization of the grades the result will be announced by the
Principal concerned.

R.19.2 Classification of successful candidates:
Candidates who have successfully completed the programme, be
classified as follows:
- Candidates securing a CGPA of 8.00 and above -
  FIRST CLASS WITH DISTINCTION
Candidates securing a CGPA between 6.50 and 7.99 – FIRST CLASS
Candidates securing a CGPA of 6.49 and less – PASS
and the same be mentioned in the Degree certificate;

R.20 Re-check/revaluation of answer Papers.
When the semester results are published, in case any student feels aggrieved, he/she can request for re-check/revaluation of answer scripts of the end semester examination. For this purpose, the student has to submit a request in the prescribed form to the Controller of Examinations/Principal within five working days from the publication of results along with the prescribed fees. When the re-check/revaluation is completed, the results will be published. If the re-check/revaluation leads to a better grade, the revised grade will be awarded to the student and in such cases, the revaluation fee will be refunded in full.

Re-check/Revaluation will be allowed only for lecture based courses.

R.21 Course Repetition
R.21.1 A student who earned an ‘F’ or an ‘FA’ grade in a core course has to repeat the course compulsorily when the course is offered later.

R.21.2 A student who earned an ‘F’ or ‘FA’ grade in an elective course may repeat it or register for an alternate elective.

R.22 Semester Grade Point Average (SGPA)
On completion of a semester, each student is assigned Semester Grade Point Average (SGPA) which is computed as below for all courses registered by the student during that semester.

Semester Grade Point Average = \( \frac{\sum (C_i \times Gp_i)}{\sum C_i} \)

where \( C_i \) is the credit for \( i^{th} \) course in that semester and \( Gp_i \) is the grade point for that course.

The summation is over all the courses registered by the student during the semester including the failed courses. The SGPA is rounded off to two decimals.

R.23 Cumulative Grade Point Average (CGPA)
The overall performance of a student at any stage of the Degree programme is evaluated by the Cumulative Grade Point Average (CGPA) up to that point of time.

\[ \text{Cumulative Grade Point Average} = \frac{\sum (C \times Gp)}{\sum C} \]

where \( C \) is the credit for \( i^{th} \) course in any semester and \( Gp \) is the grade point for that course.

The summation is over all the courses registered by the student during all the semesters up to that point of time including the failed courses. The CGPA is also rounded off to two decimals.

The ranking of the students in a batch at any intermediate or final stage is based on CGPA.

R.24 Grade Card
The Grade Card issued to the student at the end of a semester will contain the following information:

a) Code number, title and credits for each of the courses registered,
b) Letter grade secured, corresponding grade points,
c) Total number of credits earned by the student up during the semester,
d) SGPA of the semester and
e) CGPA upto and including the semester.

R.25 Transcript
The Controller of Examinations will also issue, on demand, a detailed transcript with his signature or facsimile to every student after completion of the programme. It shall contain all the information that is contained in the grade card. Additionally, it shall also include the month and year of passing each course. The transcript card shall contain only the final grades secured, but will not indicate the earlier failures, if any. The detailed transcript will contain the CGPA and the class, if any obtained. It will not, however, indicate the disciplinary actions taken against the student.

R.26 Discipline
Every student is required and expected to observe strict discipline and decorous behaviour both inside and outside the campus. He/ she should not indulge in any activity which may tarnish the fair name and prestige of Amrita Vishwa Vidyapeetham. Any act of indiscipline or misbehaviour including unfair practice in the examinations will be dealt with by the Disciplinary Action committee of the institute constituted by the Principal concerned. The committee will enquire into the charges. Based on the findings of the committee,
Principal will take appropriate disciplinary action. Serious acts of indiscipline on the part of the students may even attract penalty up to the extent of expulsion from the University.

R.27 Redress of grievances
Students have the right to seek redress of grievances. For this, they have to appeal in writing to the Principal/Dean concerned who will take necessary steps in the matter.

R.28 Award of the Degree
A student will be declared eligible for the award of Degree of Integrated M Sc, if he/she has:

a) registered and successfully completed all the courses and projects;
b) earned the required minimum number of credits as specified in the curriculum, within the stipulated time;
c) earned the specified number of credits in all the categories of courses;
d) no disciplinary action pending against him/her; and
e) no outstanding dues against him/her.

The degree will be awarded by the Board of Management of Amrita Vishwa Vidyapeetham on recommendation of the Academic Council.

R.29 Interpretation Clause
Related to any of the academic matters, whenever there arises any doubt or dispute on the interpretation of regulations or rules, the decision of the Academic Council will be final as well as binding on all concerned.

R.30 Amendment to Regulations
Notwithstanding anything stated above, the Amrita Vishwa Vidyapeetham reserves the right to modify any of the regulations, as deemed fit, from time to time.

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### CURRICULUM

<table>
<thead>
<tr>
<th>SEMESTER I</th>
<th>Course Code</th>
<th>Course Title</th>
<th>L-T-P</th>
<th>Cr</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENG101</td>
<td>Functional English</td>
<td>110</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>(Communicative English - 2010 onwards)</td>
<td>202</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHY200</td>
<td>Chemistry I</td>
<td>300</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CSA136</td>
<td>Introduction to Programming using C</td>
<td>300</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MAT101</td>
<td>Mathematical Foundations</td>
<td>310</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>PHY110</td>
<td>Mechanics</td>
<td>310</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>CSA186</td>
<td>Introduction to Programming using C Lab</td>
<td>033</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>PHY180</td>
<td>Physics Lab I</td>
<td>033</td>
<td>1</td>
<td></td>
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<tr>
<td>CUL104</td>
<td>Cultural Education I</td>
<td>100</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(from 2010 onwards)</td>
<td>200</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Total 19 (21 - 2010 onwards)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SEMESTER II</th>
<th>Course Code</th>
<th>Course Title</th>
<th>L-T-P</th>
<th>Cr</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENG102</td>
<td>Professional Communication</td>
<td>102</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>CHY201</td>
<td>Chemistry II</td>
<td>300</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CSA137</td>
<td>Programming using C</td>
<td>303</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>MAT102</td>
<td>Integration and Elementary Number Theory</td>
<td>310</td>
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<td>PHY120</td>
<td>Electricity and Magnetism</td>
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<td>PHY181</td>
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## SEMESTER III

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<tr>
<td>CHY202</td>
<td>Chemistry III</td>
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<tr>
<td>MAT201</td>
<td>Introductory Analysis and Algebra</td>
<td>3 1</td>
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<td>MAT202</td>
<td>Vectors and Ordinary Differential Equations</td>
<td>3 1</td>
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<tr>
<td>PHY206</td>
<td>History and Philosophy of Science</td>
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<td>PHY230</td>
<td>Heat and Thermodynamics</td>
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<td>PHY220</td>
<td>Basic Electronics</td>
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<td>CHY380</td>
<td>Chemistry Lab I</td>
<td>0 0</td>
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<td>PHY280</td>
<td>Basic Electronics Lab</td>
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## SEMESTER IV

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<td>Environmental Studies</td>
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<td>LSG112</td>
<td>Introduction to Life Sciences</td>
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<td>MAT203</td>
<td>Transform and Partial Differential Equations</td>
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<td>Multivariate Calculus</td>
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<td>Wave Motion and Optics</td>
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## SEMESTER V

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<tbody>
<tr>
<td>BUS108</td>
<td>Principles of Management</td>
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<tr>
<td>MAT331</td>
<td>Linear Algebra and Discrete Mathematics</td>
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<td>PHY321</td>
<td>Introduction to Electrodynamics</td>
<td>3 1</td>
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<td>PHY340</td>
<td>Relativity and Modern Physics</td>
<td>3 1</td>
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<td>STA200</td>
<td>Probability and Statistics</td>
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<td>Chemistry Lab II</td>
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## SEMESTER VI

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<td>Introductory Real Analysis</td>
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<td>MAT311</td>
<td>Complex Analysis</td>
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<tr>
<td>PHY341</td>
<td>Solid State Physics and Devices</td>
<td>3 1</td>
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<tr>
<td>PHY342</td>
<td>Atomic, Molecular and Nuclear Physics</td>
<td>3 1</td>
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<td></td>
<td>Elective (Mathematics/Physics)</td>
<td>3 0</td>
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<td>MPJ398</td>
<td>Seminar</td>
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<td><strong>Total 28 (28 for Exit Option students)</strong></td>
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<tr>
<td>MPJ399</td>
<td>Project (for students exercising Exit Option)</td>
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Total credits at the end of VI semester - 122 (125 - 2010 onwards) (130 for Exit Option students - 2009 batch and 135 for Exit Option students - 2010 batch onwards)

## VI SEMESTER ELECTIVES

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>MAT322</td>
<td>Introduction to Discrete Mathematics</td>
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<tr>
<td>MAT332</td>
<td>Introduction to Operations Research</td>
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<td>PHY252</td>
<td>Physics of Semiconductor Devices</td>
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<td>PHY260</td>
<td>Physics of Lasers and Applications</td>
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<td>PHY262</td>
<td>Introduction to Nonlinear Dynamics</td>
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<tr>
<td>PHY343</td>
<td>Mathematical Aspects of Mechanics</td>
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## SEMESTER VII

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<tr>
<td>MAT411</td>
<td>Advanced Complex Analysis</td>
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<tr>
<td>PHY410</td>
<td>Classical Mechanics</td>
<td>4 0</td>
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<tr>
<td>PHY430</td>
<td>Quantum Mechanics I</td>
<td>4 0</td>
<td>4</td>
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<td>PHY432</td>
<td>Mathematical Physics</td>
<td>3 0</td>
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<td>MPJ480</td>
<td>Simulation Lab</td>
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<td>PHY481</td>
<td>Physics Lab A</td>
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### Integrated M Sc (Mathematics Stream)

**SEMESTER VIII**

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<tr>
<td>MAT413</td>
<td>Theory of Ordinary Differential Equations</td>
<td>400</td>
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<td>MAT414</td>
<td>Topology</td>
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<td>MAT420</td>
<td>Linear Algebra</td>
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<td>MAT430</td>
<td>Discrete Mathematics</td>
<td>300</td>
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<td>Real Analysis II</td>
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**SEMESTER IX**

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<tr>
<td>MAT509</td>
<td>Differential Geometry</td>
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<tr>
<td>MAT511</td>
<td>Measure and Integration</td>
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<td>MAT513</td>
<td>Theory of Partial Differential Equations</td>
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<td>Advanced Algebra</td>
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<td>Mathematics Elective I</td>
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**SEMESTER X**

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<td>Mathematics Elective III</td>
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### Integrated M Sc (Physics Stream)

**SEMESTER VIII**

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<td>PHY400</td>
<td>Experimental Techniques</td>
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<td>PHY420</td>
<td>Advanced Electrodynamics</td>
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<tr>
<td>PHY431</td>
<td>Quantum Mechanics II</td>
<td>400</td>
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<td>PHY433</td>
<td>Advanced Mathematical Physics</td>
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<td>PHY499</td>
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**SEMESTER IX**

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<td>PHY510</td>
<td>Statistical Mechanics</td>
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<td>PHY520</td>
<td>Advanced Electronics</td>
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<td>PHY540</td>
<td>Nuclear and Particle Physics</td>
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<td>PHY541</td>
<td>Condensed Matter Physics I</td>
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**SEMESTER X**

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<td>Physics Elective I</td>
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Total Credits for the 5-year Integrated M Sc programme = 197 (200 – 2010 onwards)
### PHYSICS ELECTIVES

- PHY450: Fundamentals of Plasma Physics
- PHY451: Space Physics
- PHY452: Nonlinear Dynamics
- PHY453: Optoelectronics
- PHY454: Introduction to Nanophysics and Applications

### MATHEMATICS ELECTIVES

- MAT422: Algebraic Number Theory
- MAT431: Calculus of Variations
- MAT501: Analytic Number Theory
- MAT514: Operator Theory
- MAT515: Integral Equations
- MAT521: Algebraic Topology
- MAT530: Continuum Mechanics
- MAT531: Advanced Operations Research
- MAT540: Combinatorics
- MAT541: Advanced Graph Theory
- MAT542: Automata Theory
- STA430: Probability Theory
- STA431: Stochastic Processes
- STA432: Statistical Inferences

---

**SYLLABUS**

**BUS108 PRINCIPLES OF MANAGEMENT 2022**

Introduction to management, definition, nature and importance, role and skills of a manager, Planning, nature and purpose of planning, objectives of planning, steps in planning, Strategic policy, goal setting, decision making, SWOT analysis, organization structure, Departmentalization, line staff authority, principles of staffing, Performance appraisal, career strategy, Leading, managing human factor, leadership, communication, controlling the system and the process, introduction to management functional areas - Marketing, HR, Production and specialization, finance, Management Information System - managerial functional areas.

**TEXTBOOK:**


**REFERENCE:**


**CHY300 CHEMISTRY I 3003**

Structure of the Atom and Chemical Bonding: Shape of atomic orbitals, nodal planes, degeneracy of atomic orbitals and behaviour of orbitals in external magnetic and electric fields, L - S coupling, j - j coupling, Schrodinger's wave equation - derivation, eigen values and eigen functions, normalization and orthogonality of wave function, operators in wave mechanics, postulates of quantum mechanics, applications of wave mechanics - electron in a ring and particle in a one-dimensional box, probability distribution curves for orbitals.

Molecular orbital theory - postulates and application to heteronuclear diatomic species such as HCl, NO, CO and NO₂. Metallic bond, theories of metallic bond - free electron theory, valence bond approach and band theory (conductors, insulators and semiconductors) - their successes and limitations.

Chemistry of Elements: Metallurgy, properties (physical and chemical), important compounds and alloys and uses of elements such as titanium, zirconium, tungsten, lanthanides, thorium, uranium and plutonium.

Nuclear Chemistry: Size of the nucleus, nuclear forces - Yukawa theory, structure of the nucleus - shell model and liquid drop model, stability of the nucleus - N/P ratio, packing fraction, mass defect and binding energy, radioactivity - alpha and beta particles and gamma radiation and their properties, detection and measurement of radioactivity - Geiger-Muller Counter and Wilson Cloud Chamber, isotopes,

The Kinetic Theory of Gases: Kinetic molecular theory of gases – postulates, kinetic gas equation – derivation, explanation of Boyle’s law, Charles’ law, Avagadro’s law, Graham’s law of diffusion and Dalton’s law of partial pressure. Based on Kinetic theory (kinetic gas equation), kinetic energy of gases in terms of universal gas constant and Boltzmann constant, molecular velocities – most probable, average, mean square and root mean square velocities – expressions from Maxwell’s equation for calculating these velocities (derivations not expected), molecular collisions in a gas – collision diameter, collision cross-section, collision number, collision frequency and mean free path – their calculations, specific heat capacity at constant volume \( C_v \) and at constant pressure \( C_p \), molar heat capacity at constant volume \( C_v \) and at constant pressure \( C_p \), relation between \( C_v \) and \( C_p \), ratio of \( C_v \) and \( C_p \) for monatomic, diatomic and triatomic gases.

Behaviour of Real Gases: Limitation of Ideal gas equation, compressibility factor, Boyle temperature, deviation from ideal behaviour – explanation, van der Waals equation of state for real gases – derivation and its different forms at different pressures and temperature, Boyle temperature from van der Waals constant, significance of van der Waals constants, critical phenomena and their determination, \( P-V \) isotherms of \( CO_2 \), calculation of critical phenomena from van der Waals constants.

(\textbf{Note – Problems are compulsory})

\textbf{TEXTBOOKS:}

3. "Advanced Physical Chemistry" by Gurdeep Raj. GOEL Publishing House (a unit of KRISHNA Prakashan Media (P) Ltd) 11, Shivali Plot, Meerut, U.P.

\textbf{REFERENCES:}


\textbf{SCHOOL OF ARTS AND SCIENCES}
Polymer Chemistry: Monomers and polymers, condensation and addition polymerizations and co-polymerization, mechanism and kinetics of free radical addition polymerization, polymerization techniques - bulk, solution, suspension and emulsion polymerizations, molecular weight distribution, number average and weight average molecular weights, determination of molecular weights - viscosity, ultracentrifuge, light scattering and GPC methods (qualitative treatment), Inorganic polymers - silicones and phosphazenes, biodegradable polymers, synthesis, characteristics and applications of some industrial polymers - Nylon 6, 10, Nylon 66, Nylon 6, rayon, UF and PF resins, epoxy resins and PTFE.


Conducting Polymers - Introduction, intrinsically conducting polymers (conducting polymers having conjugated and doped conducting polymers - p-doping, n-doping, polaron, bipolaron), extrinsically conducting polymers (conductive element filled polymers and blended conducting polymers), applications of conducting polymers.

Liquid Crystals - introduction, different types of liquid crystals, properties, applications.

TEXTBOOKS:
2. "Advanced Physical Chemistry" by Gunvinder Raj. GOEL Publishing House (a unit of KRISHNA Prakashan Media (P) Ltd) 11, Shivaji Road, Meerut, U.P.

REFERENCES:
3. "Physical Chemistry" by P.W. Atkins. ELBS.
CHY380 CHEMISTRY LAB 1

1. Estimation of sodium hydroxide using A.R sodium carbonate
2. Estimation of oxalic acid
3. Estimation of famous ion using internal indicator
4. Estimation of iodine
5. Estimation of Zinc
6. Estimation of Total, Permanent and Temporary Hardness of Water
7. Acid hydrolysis of Ethyl Acetate - Kinetic Aspects
8. Potentiometric titration of Fe²⁺ against Cr₂O₇²⁻
9. Conductance measurement
10. Acid base titration by conductometric titration

CHY381 CHEMISTRY LAB II

1. Determination of critical solution temperature of phenol-water system
2. Determination of partition co-efficient of iodine between carbon tetrachloride and water
3. Determination of transition temperature of sodium thiosulphate pentahydrate
4. Thin Layer chromatography
5. Determination of heat of neutralisation of hydrochloric acid and sodium hydroxide
6. Determination of normality by pH meter
7. Estimation of phasal
8. Determination of % of copper in brass
9. Polymer preparation
10. Potentiometric titration of Fe²⁺ against Cr₂O₇²⁻

CSA136 INTRODUCTION TO PROGRAMMING USING C

Computer - History, Generations, classifications, applications, input output devices, hardware units, algorithms and flowchart. What is a program?


A little introduction to C, Writing a Program, Getting started with compiler, Alphabets in C, Keywords in C, Rules of forming Words in C language, Data Variables, Data Types and Rules for naming and declaring data variables

Basic Data Types in C, Constants, Rules for forming Sentences in C, Comments in C, Enumerated Data Types, Type Definitions, Input/Output Instructions.

SYLLABI Integrated M Sc (Mathematics/Physics) 2009 admission onwards

Operators, Decision Control Instructions: if, if-else, if-else-if, Nested if-else,
Conditions, Loop Control Instructions: For Loop, While Loop, Do While, What are strings? String I/O, String Manipulation Functions, Storage Classes and Scoping: Automatic, Register, External, Static, Scope of a Variable.

Arrays: What is an array?: Array Declaration, Array Initialization, Accessing individual elements of an array, Two Dimensional Arrays, Accessing the elements of a two dimensional array, More than two dimensions: Passing an array element to a function, Rules of using an array.

Functions: Why use Functions, Components of Function, Name of a function, Body of a function, Local variables of a function, Parameters or Arguments to a function, Return Values, Prototype of a function, Rules of using a function.

Structures: Declaring and Accessing Structure, variables Uses of Structures.

TEXTBOOKS:
1. Let Us C – Yaseen Kandare
2. Computer Programming in C – V Rajaraman

REFERENCES:
1. Mastering C, K R Venugopal, S R Prasad
2. Computer Concepts and C programming, Anami

CSA137 PROGRAMMING USING C 3 0 3 4

Functions
Types of functions - User defined functions - Structure of a function - Execution Process of a function - Category of Functions - Function Prototyping - Nesting of Functions - Sending arrays to functions - Recursion

Structures
Structure Definition - Structure Initialization - Nesting of Structure - Arrays and Structures - Structure to functions

Pointers
Accessing the address of a variable - Declaring and initializing a pointer - Accessing variable through its pointer - Pointer to Pointer - Pointers and functions - Dynamic memory allocation

Data Structures in C
Overview of Data Structures - Primary Forms - Linked List, Queue, Stack

Schools of Arts and Sciences
AMRITA VIJAYA VIDYAPEETHAM

S 6
The Pre Processor
Preprocessor Directives - Macro Substitution directives - Command Line Arguments
- bitwise Operators

File Management in C
File Operations - VO Operations on files - General Formats for declaring and opening a File

CSA186 INTRODUCTION TO PROGRAMMING USING C LAB 0 0 3 0

Computer Labs based on CSA136

CUL101 CULTURAL EDUCATION I 1 0 0 1
(for 2009 batch only)

1. Introduction to Indian culture, definition and dimensions of Indian culture - need for awareness of cultural heritage, link between culture and values
2. Introduction to Amma's Life and Teachings
   Anecdotes from Amma's life and conversations with disciples, illustrating various cultural and spiritual values
3. Symbols of Indian culture
   Forms, meanings and significance of symbols-religious symbols - Seashika, Omkara, Lingam, Lotus, Titik, Radhakini, Shankha and Salagrama
4. Science and technology in Ancient India
   Highlights of India's contribution in the fields of mathematics, astronomy, metallurgy and medicine
5. Education in ancient India
   Ancient Indian educational system, the schools in 10th century, comparison with English education (from Dharpa's beautiful tree)
6. Goals of life - Purusharthas - Dharma, Artha, Kama, Moksha
7. Introduction to Vedanta and Bhagavad Gita: respect for nature in Indian culture, sacredness of the universe, rivers, mountains, volcanoes and atlases, Prakriti, Kriya, Krsna
8. General section
   The Sindhu Saraswatya civilization, bridge of Rama - Ramasthu, the Holy city of Dwarka, the myth of Aryan invasion theory
9. Saints and seers of India - Veda Vyasa, Vishwamitra, Buddha, Mahavira, Adi Shankaracharya, Sri Ramakrishnacharya, Sri Medavacharya, Chaitanya Mahaprabu, Guru Nanak, Kabir etc., students projects on any of the saints and seers of India

Syllabi
Integrated M.Sc (Mathematics/Physics) - 2009 admissions onwards

REFERENCE BOOKS:
1. Eternal, talented India - Poems, Vivekananda Life Skills Academy publication
2. Mother of India, AAM publication
Note: Handout will be given to students occasionally, which will also serve for the purpose of a text book.

CUL102 CULTURAL EDUCATION II 1 0 0 1
(for 2009 batch only)

Bhagavad Gita and Life Management - Leadership, Teamwork, Motivation, Sense Management, Mind Management

Historicity of Ramayana and Mahabharata - Are Rama and Krishna historical characters? Is there evidence to prove the historicity of Ramayana and Mahabharata? Inspiring stories and characters from the epics.

Overview of Patanjali's Yoga Sutras with focus on value systems mentioned in Yama and Niyama.

Highlights of Indian Mythology - 15 Puranas, Vyasa, Inspiring Stories and Characters from the Puranas - Dhanur, Prahlada, Markandeya etc.

Indian Society: Its Strengths and Weaknesses - Discussion on strengths &
weaknesses of Indian society – family values, social values, community values etc., varnashrama, caste, dowry etc.

Role & Position of Women in Indian Society – Great women of India, rishikas in the vedas, women characters in the epics, decline of women’s status.

Indian Models of Economy, Business and Management – how cultural values influence Indian economic processes, economic history of India.


Conservation of cultural heritage – changing value systems in India – open debate on globalisation and its impact – role of youth in protecting and promoting Indian Culture & Heritage.

Life and work of Great Seers of India (2) – Nagarjuna, Padmasambhava, Swami Narayan, Sri Ramakrishna Paramahamsa, Swami Vivekananda, Sri Ramana Maharshi, Sri Aurobindo, Narayana Guru, Swami Chinmayananda, Peace Pilgrim, Dalai Lama, Antony De Mello and others – group presentations or project work to be done by students on the life and teachings of any one of the saints & seers.

TEXTBOOK:

REFERENCE BOOKS (COMMON FOR BOTH SEMESTERS):
1. Awaken Children Series (Vol 1-8), Mata Amritanandamayi Math
2. Chanakya – Collected Writings, Other India Press, Mumbai
3. Pride of India, Sanskriti Bharati
4. Symbolism in Hinduism, Chinmay Mission
5. Complete Works of Swami Vivekananda, Ramakrishna Math
6. Bhagavad Gita, Commentary by Swami Ranganathananda, 3 volumes, Sri Ramakrishna Math
7. Asana, Pranayama, Mudra and Bandha by Swami Satyananda Saraswati, Bihar School of Yoga
8. Meditation and Spiritual Life by Swami Yogananda, Sri Ramakrishna Math
9. Great Women of India, Sri Ramakrishna Institute of Culture, Kolkata
10. Saints & Mystics of India, Sri Ramakrishna Math
11. Learn to Live (2 vol), Swami Jagadishananda, Sri Ramakrishna Math
12. The Art of Man Making, Swami Chinmayananda, Chinmay Mission
13. India’s Contributions to World Thought and Culture, Vivekananda Kendra Patika
14. Tuls on Vedic Culture and Tradition by Swami Pranavananda Saraswati
15. Ramayana & Mahabharata by C. Rajagopachari, Bharathi Vidya Bhavan

CUL102 CULTURAL EDUCATION II
(for 2010 admissions onwards)

Bhagavad Gita and Life Management
Historicity of Ramayana and Mahabharata
Overview of Patanjali’s Yoga Sutras
Highlights of Indian Mythology
Indian Society: Its Strengths and Weaknesses
Role & Position of Women in Indian Society
Indian Models of Economy, Business and Management
Health and Lifestyle related issues
Conservation of cultural heritage
Life and work of Great Seers of India (2)

TEXTBOOKS:
1. The Glory of India (In-house publication)
2. Santastha Dharma (A compilation of Asama’s teachings on Indian Culture)

ENG101 FUNCTIONAL ENGLISH
(for 2009 batch only)

Successful managers not only demonstrate excellent communication skills, they also make effective choices as they adapt their communication to a variety of purposes and audiences. This introductory course is an opportunity to run through the fundamentals inherent in English language.

Course Objectives:
1. Strengthen the foundation in English of the learners
2. Make learners capable of handling English usage to suit basic needs.

Selections in prose and poetry – as an aid to teach the elements of grammar and to illustrate usage of the following language components:
1. Elements of Grammar
   - Parts of Speech (including Linkers): Tenses; Concord (Sub/Verb/ Antecedent); Punctuation; Articles; Basic sentence structures (assertive/ interrogative/ imperative/ exclamatory); Phrases and Clauses; Synthesis and Transformation of Sentences
2. Paraphrasing and Summarising
3. Guided Paragraph Writing (writing stories from given cultural framework, expansion of proverbs and the like)
4. Letter writing (Formal Leave letters/ other Request Letters)
5. Reading Practice and comprehension
6. Short speeches (Practical/ Class room work); Narration of incidents / stories / anecdote; Extimpore (pick and speak)
TEXTBOOK:

REFERENCE TEXTS:
3. Raymond Murphy, Murphy's English Grammar, Cambridge University Press, 2004

COMMUNICATIVE ENGLISH
(for 2010 batch onwards)

OBJECTIVES: to make the student familiar with English syntax - to help the student to obtain ability to communicate - to impart an aesthetic sense and enhance creativity

Module 1
Parts of Speech, Kinds of sentences (declarative, imperative, interrogative, exclamatory)
Analysis of patterns of sentences (SVOCA... ) Types of sentences (simple, complex, compound): Transformation of sentences.

Module 2
Verbs: Regular and irregular, Tenses, Voice, Concord

Module 3 Composition
Letter Writing: personal (Letters of request, invitation, felicitation, gratitude, condolence...), Paragraph writing (personal topics) Essay writing, Reading Comprehension,

Module 4 Speaking
Narration of incidents/stories/anecdotes, Situational dialogues.

Module 5
Selected essays, Short Stories and Poems

REFERENCES:
1. Sreenivasan S. Functional Grammar and Communicative Skills, Century publishers, Kalam
2. Seely, John. Writing and Speaking, Delhi, 1988
3. Nanyena Sowmy, V.R. Strength Your Writing, Orient Longman
4. Syamala, V. Speak English in Four Easy Steps, Improve English Foundation Thiruvananthapuram 2006

Syllabi
Integrated M Sc (Mathematics-Physics) 2008 admissions onwards

ENG102 PROFESSIONAL COMMUNICATION

Module 1 Sentence: Transformation and Synthesis, Reported Speech, Error Analysis

Module 2 Paragraph (General Topics), Official Letters, Job Application, Resume, Instruction, Suggestion & Recommendation

Module 3 Reports, Circulars, Memos

Module 4 Mock Press, Interviews, Role play, Group Discussion, Situational Conversation

Module 5 Book Review

REFERENCES:
1. Felipe Echey. Tech Talk, University of Michigan, 2000

ENV101 ENVIRONMENTAL STUDIES

The Multidisciplinary nature of Environmental Studies, Definition, scope & importance, need for public awareness, Natural Resources, Renewable and non-renewable resources, Natural Resources and associated problems, Role of individual in conservation of natural resources, Equitable use of resources for sustainable lifestyles

Ecosystems, Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Ecological succession, Types of ecosystems

Biodiversity and its conservation, Species & ecosystem diversity, Biogeographical classification of India, Value of biodiversity, Biodiversity at global, national & local levels, India as mega-diversity nation, Hotspots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity:

Environmental Pollution, Definition, Causes, Effects and control measures, Solid Waste Management, Role of the individual in the prevention of pollution, Pollution Case Studies, Disaster management

Syllabi
Integrated M Sc (Mathematics-Physics) 2008 admissions onwards

S.R.
Schools of Arts and Sciences


Field Work: Visit to local area to document environmental assets, Visit to local polluted sites/ environmental disaster sites, Study of common plants, insects, birds, Study of local ecosystem.

TEXTBOOK:

LSQ112 INTRODUCTION TO LIFE SCIENCES 4 0 4

Introduction to biology - Life, space biology, basic life functions, energetic thermodynamics and life, comparison between computers and life, basis of life, principles of biology, Astrobiology goals and objectives.

Cells and life - Eukaryotic cells, Mitosis overview, Components of cells, Prokaryotic cells, differences between eukaryotes and prokaryotes, cellular dynamics, features like oxygen transport, electrical activity, circadian rhythms.

Brain - Brain as a model biological system, basic physiology and functions, brain as a physical system (self organization, complex functions from simple parts), Insights into the physics of brain activity.

Mathematical models in biology - Introduction, types of models, levels of modeling, specificity of modeling in biology, Some standard models - unlimited growth.

Basic of biophysics - Mathematical fundamentals, Experimentation and computation, preliminary neurophysiology, principles of modeling, basic neuronal computation, patch clamp technique, Membrane equation (Fick's, Ohm's, Einstein's equations, Nernst potential), R-C circuits.

Biophysics of computation - Neuronal computation, neuronal code, cellular basis of learning and memory, computational learning and memory in neuronal circuits.

REFERENCE BOOKS:

MAT101 MATHEMATICAL FOUNDATIONS 3 1 0 4

Unit 1: Logic, Real numbers and the real line, Coordinates, lines and increments, Functions, shifting of graphs and trigonometric functions, Sets and functions, Mathematical Induction. Finite and infinite sets.

Unit 2: The algebraic and order properties of \( \mathbb{R} \), Absolute value and real line. The completeness property of \( \mathbb{R} \), applications of supremum property, intervals.

Unit 3: Limits and continuity- Rate of change of limits, rules for finding limits, Formal definition of limits, Extensions of the limit concept. Continuity, Tangent lines.

Unit 4: The derivative of a function, Rates of change, Implicit differentiation and rational exponents, Applications of derivatives, The mean value theorem (without proof). The first derivative test for local extreme values, Graphing with \( f ' \) study . Linearization and differentials, Newton's method.

CAS Explorations and projects based on the topics.

TEXTBOOKS:
3. MTTS Problem set.

MAT102 INTEGRATION AND ELEMENTARY NUMBER THEORY 3 1 0 4

Unit 1: Integration, curve tracing - plotting the graph of functions, Indefinite integrals, Differential equations, Initial value problems, integration by substitution, Riemann sums and definite integrals, properties, Area and the mean value theorem (without proof), fundamental theorem (without proof), numerical integration.

Unit 2: Area between curves, finding volumes by slicing, Volumes of solids of revolution, Lengths of plane curves, Areas of surface of revolution, moments and centers of mass, work, Fluid pressures and forces and other modeling applications.
Unit 3: Transcendental functions, inverse functions and their derivatives, natural logarithms and the exponential function, L’Hospital’s rule, inverse trigonometric functions, Derivatives of inverse trigonometric functions, Hyperbolic functions, first order differential equations and Euler’s numerical method. Techniques of integration, integration by parts, Partial fractions, Improper integrals.


CAS Explorations and projects based on the topics

TEXTBOOKS:
1. Thomas and Finney, Calculus, 8th edition, Pearson education
4. MTS5 Problem set

MAT201 INTRODUCTORY ANALYSIS AND ALGEBRA 3 1 0 4

Unit 1: Sequences and series: Sequences and their limits, limit theorems, monotone sequences, subsequences and the Bolzano-Weierstrass theorem, Cauchy Criterion, introduction to series

Unit 2: Limits: Limits of functions, limit theorems, extensions of the limit concept, Continuous functions, combination of continuous functions, continuous functions on some intervals, and uniform continuity

Unit 3: Simultaneous equation in two variables, discriminants, Separation of repeated roots, cubic and quadratic equations

Unit 4: Linear equations and matrices: Systems of linear equations, Gaussian elimination, surns and scalar multiplication of matrices, products of matrices, Block matrices, inverse of matrices, LDU factorization and applications. Determinants, properties, existence and uniqueness, cofactor expansion, Cramer’s rule and applications.

CAS Explorations and projects based on the topics

TEXTBOOKS:
1. Thomas and Finney, Calculus, 8th edition, Pearson Education
MAT203 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS 3 1 0 4

Unit 1: Groups, subgroups, isomorphism, automorphism, homomorphism, normal subgroups and factor groups.

Unit 2: Rings, homomorphism and isomorphism, the concept of field of quotients, polynomial rings, ideals, residue class rings, divisibility, prime ideals, Euclidean rings and principal ideal rings, factorization.

Unit 3: Transforms - Laplace transforms, Solution of initial value problems, Step functions, Impulse functions, Convolution integral, Fourier series, Fourier Convergence theorem, Even and odd functions.

Unit 4: Partial differential equations (p. d. e) Two point boundary value problems, Separation of variables, Heat equation, Wave equation and Laplace's equation and numerical solutions of p. d. e.

TEXTBOOKS:
1. B. L. Van der Waerden, Algebra, Springer
2. I. N. Herstein, Topics in Algebra, 2nd Edition

MAT211 MULTIVARIATE CALCULUS 3 1 0 4

Unit 1: Multivariable Functions and Partial Derivatives - Functions of several variables, limits and continuity, partial derivatives, differentiability, lineazation and differentials, partial derivatives with constrained variables, Directional derivatives, gradient vectors and tangent planes, extreme values and saddle points, Lagrange multipliers and Taylor's formula.

Unit 2: Multiple integrals - Double integrals, areas, moments and center of mass, double integrals in polar form, triple integrals in rectangular coordinates, masses and moments in three dimensions, Triple integrals in cylindrical and spherical coordinates and substitutions in multiple integrals.

Unit 3: Integration in vector fields - Line integrals, vector fields, work, circulation and flux, Path independence, potential functions and conservative fields, green's theorem in the plane, surface area and surface integrals, parametrized surfaces, Stokes's theorem, The divergence theorem, and a unified theory.

CAS Explorations and projects based on the topics.

Schools of Arts and Sciences

MAT310 INTRODUCTORY REAL ANALYSIS 3 1 0 4

Unit 1: Differentiation: The derivative, The mean value theorem, L'Hospital's rule, Taylor's theorem.

Unit 2: The Riemann integral, Riemann integrable functions, the fundamental theorem, approximate integration.

Unit 3: Point wise and uniform convergence, interchange of limits, the exponential and logarithmic functions, trigonometric functions.

Unit 4: Absolute convergence, tests for absolute convergence, tests for non absolute convergence, series of functions.

TEXTBOOKS:
3. MAT71 Problem set.

MAT311 COMPLEX ANALYSIS 3 1 0 4

Unit 1: Complex numbers, algebra of complex numbers, functions of a complex variable, limits, continuity and differentiability, Cauchy-Riemann equations, harmonic functions. Elementary functions - exponential function, trigonometric functions, hyperbolic functions, logarithmic function, complex exponents and inverse trigonometric functions.

Unit 2: Conformal mappings, bilinear transformation, exponential and trigonometric transformations.
Complex Integration - contour integral, Cauchy-Goursat theorem (with out proof), Cauchy integral formula, some consequences of Cauchy integral formula.

Unit 3: Sequences and series - sequences, series, sequence of functions, series of functions, power series, uniform convergence of power series, Taylor series.
zeros of analytic functions. Laurent series, integration and differentiation of power series.

Unit 4: Singularities and residues - classification of singularities, residues, poles and zeros, behavior of functions at infinity.

(Importance for working problems rather than proving theorems)

TEXTBOOK:
R.S. Kesson. Complex Variables. Theory and applications; 2nd edition, prentice hall India

MAT322 INTRODUCTION TO DISCRETE MATHEMATICS 3 0 0 3


Relations and Their Properties, N-Ary Relations and Their Applications, Representing Relations, Closure of Relations, Equivalence Relations, Partial Ordering.

Graph Theory: Introduction to Graphs, Graph Operations, Graph and Matrices, Graph Isomorphism, Connectivity, Euler and Hamilton Paths, Shortest Path Problem, Planar Graph, Graph Colouring.

TEXTBOOKS:

REFERENCES:

MAT331 LINEAR ALGEBRA AND DISCRETE MATHEMATICS 3 1 0 4

Unit 1: Vector spaces, n spaces, subspaces, bases and dimension, rank and nullity, invertibility, applications.

Unit 2: Linear transformations - Basic properties, matrices of linear transformations, vector space of linear transformations, change of bases, similarity, applications. Polynomials, the zeros of a polynomial, and factorization.

Unit 3: The basics of counting, the pigeonhole principle, permutations and combinations, generalized permutations and combinations, recurrence relations, divide and conquer relations, generating functions and inclusion-exclusion.

Unit 4: Introduction to Graphs, representing graphs and graph isomorphism, connectivity, Euler and Hamiltonian paths, planar graphs, graph coloring, trees, trees and sorting, spanning trees and minimum spanning trees.

TEXTBOOKS:

MAT333 INTRODUCTION TO OPERATIONS RESEARCH 3 0 0 3


Unit 2: Transportation and its variants: Definition, Transportation Algorithms and Solutions, Assignment Model, Hungarian Method, Travelling Salesman Problem.


Unit 4: Work Break down Structures, Network logic, Critical Path, CPM Vs PERT, Slack and Floats.

TEXTBOOKS:

REFERENCE TEXTS:
**MAT411** ADVANCED COMPLEX ANALYSIS  400 4


**TEXTBOOKS:**
1. L. Ahlfors, Complex Analysis, McGraw-Hill.
2. J.B. Conway, Functions of one complex variable, Springer.

**MAT413** THEORY OF ORDINARY DIFFERENTIAL EQUATIONS  400 4


**TEXTBOOKS:**
1. G.F. Simmons, Differential Equations with Applications and Historical Notes, McGraw-Hill.

**MAT414** TOPOLOGY  400 4


**SYLLABUS** (Integrated M Sc. (Mathematics) Physics) 2009 admissions onwards

**MAT420** LINEAR ALGEBRA  400 4


**TEXTBOOKS:**

**MAT422** ALGEBRAIC NUMBER THEORY  300 3

UNIT 1: Algebraic background - Algebraic numbers - Quadratic and cyclotomic fields - Factorization into irreducibles (i).

UNIT 2: Factorization into irreducibles - Examples of non-unique factorization into irreducibles, Prime factorization, Euclidean domains, Euclidean quadratic fields. Theorem 4.20 of the equation $y^2 + 4 = z^2$. (Ramanujan-Nagell Theorem excluded).


**TEXTBOOK:**

**REFERENCES:**
MAT430  DISCRETE MATHEMATICS  3 0 0 3

Propositional Logic, Equivalences, Predicates and Quantifiers, Sets, Functions and growth of functions, Basic Counting Principles, Generating Functions, Recurrence Relations, Inclusion - Exclusion Principles, Euler's phi-function and its Application to Cryptography. Relations and their properties, n-ary relations, Equivalence relations, Graphs, Bipartite Graphs, Planar graphs, Eulerian and Hamiltonian Graphs, Graph coloring, Trees, Minimum Spanning Trees, Depth First search, Breadth First Search, Shortest Path Algorithms, Finite Automata. Languages Accepted by Finite state Machines, Regular Expressions, Pumping Lemma for Regular Languages.

TEXTBOOK:

MAT431  CALCULUS OF VARIATIONS  3 0 0 3

UNIT 1

FURTHER GENERALIZATIONS: The fixed end-point problem for unknown functions. Variational problems in parametric form. Functional depending on higher order derivatives. Variational problems with subsidiary conditions.

UNIT 2
THE GENERAL VARIATION OF A FUNCTIONAL: The derivation of the basic formula. End-points lying on two given curves or Surfaces. Broken extremals. The Weierstrass-Erdmann conditions.


MAT500  DIFFERENTIAL GEOMETRY  3 0 0 3

Curves in the plane and in space, arc-length, reparametrization, level curves. Parametrized curves, curvature, plane curves, space curves. Global properties of curves. The isoperimetric inequality, the four vertex theorem. Surfaces in three dimensions, smooth surfaces, tangents, normals and orientability. Quadratic surfaces, triply orthogonal systems. Applications of inverse function theorem, the first fundamental form, lengths of curves on surfaces. Isometric surfaces, conformal mapping. The mean curvature and the mean curvatures. The Gaussian curvature and the mean curvature. The Gaussian curvature of a surface. The Gauss map.

TEXTBOOK:
Andrew Pressley. Elementary differential geometry.

MAT501  ANALYTIC NUMBER THEORY  3 0 0 3

Reciprocity law, Jacobi Symbol, Primitive roots, existence and number of primitive roots.

TEXTBOOK:

REFERENCES:
1. Emil Grosswald, Topics from the theory of numbers, Birkh"auser
2. G.H Hardy and E.M.Wright, Introduction to the theory of numbers, Oxford

MAT510
REAL ANALYSIS II
4 0 0 4

Riemann-Stieltjes integral, upper and lower sums as area under a curve. Integrability of continuous functions, Fundamental theorem of Calculus, integration by parts, rectifiable curve. Sequence and series of functions, Uniform convergence, line of continuous and differentiable functions under uniform convergence, integration under uniform convergence. Equicontinuity, Stone-Weierstrass theorem. Power series: Basic theorems about convergence and continuity of a power series, radius of convergence, behaviour at the end points. Exponential and trigonometric functions. Fourier series, basic convergence theorem, Parseval's theorem. Functions of Several variables: Derivative of a function from \( \mathbb{R}^n \) to \( \mathbb{R}^m \) as a linear map, partial derivative. Chain rule, Inverse and Implicit function theorems.

TEXTBOOKS:
2. T. Apostol, Mathematical Analysis, Narosa.
3. H.L. Royden, Real Analysis, Prentice-Hall.

MAT511
MEASURE AND INTEGRATION
4 0 0 4

\( \mathcal{A} \)-algebra of sets, measurable sets and measures, extension of measures, construction of Lebesgue measure, integration, convergence theorems, Radon-Nikodym theorem, product measures, Fubini's theorem, differentiation of integrals, absolutely continuous functions (as e.g., in Royden, Chapter 9), Lp-spaces, Riesz representation theorem for the space \( C[0, 1] \).

TEXTBOOKS:
1. H.L. Royden, Real Analysis, Prentice-Hall.
2. W. Rudin, Real and Complex Analysis, McGraw-Hill.

MAT512
FUNCTIONAL ANALYSIS
4 0 0 4


TEXTBOOKS:
1. S.V. Limsay, Functional Analysis, Wiley
2. G.A. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill.

MAT513
THEORY OF PARTIAL DIFFERENTIAL EQUATIONS
4 0 0 4


TEXTBOOK:
A. John, Partial Differential Equations.

MAT514
OPERATOR THEORY
3 0 0 3

Bounded Linear Maps on Banach Spaces: Spectrum of a Bounded operator, Compact linear maps, Spectrum of a compact operator, Fredholm alternative.


REFERENCES:
MAT 515 INTEGRAL EQUATIONS 3003


TEXTBOOK:

REFERENCES:

MAT 621 ALGEBRAIC TOPOLOGY 3003

UNIT 1: Geometric Complexes and Polyhedra: Introduction, Examples, Geometric Complexes and Polyhedra; Orientation of geometric complexes. Simplicial Homology Groups: Chains, cycles, Boundaries and homology groups. Examples of homology groups: The structure of homology groups; The Euler Poincare Theorem; Pseudomanifolds and the homology groups of $S^2$.

UNIT 2: Simplicial Approximation: Introduction; Simplicial approximation; Induced homomorphisms on the Homology groups; The Brouwer fixed point theorem and related results; The Fundamental Group: Introduction; Homotopic Paths and the Fundamental Group; The Covering Homotopy Property for $S^2$.

UNIT 3: Examples of Fundamental Groups; The Relation Between $H_n(X)$ and $H_n(S^n)$; Covering Spaces: The definition and some examples. Basic properties of covering spaces. Classification of covering spaces. Universal covering spaces. Applications.

TEXTBOOK:
FRED H. CROOKE: BASIC CONCEPTS OF ALGEBRAIC TOPOLOGY, UTM, Springe Verlag NY (1976)

REFERENCES:

MAT 320 CONTINUUM MECHANICS 3003


REFERENCE:
Huntley, S.C., Mechanics of Continuous Media
MAT531 ADVANCED OPERATIONS RESEARCH 3.0 0.3

Linear programming; Mathematical formulation of industrial problems in LPP models, Simplex method, Theorem on Simplex method, Two phase method, Big M method, Degeneracy in LPP.

Concept of duality in LPP, Dual simplex method, Fundamental theorem of duality, Sensitivity Analysis, Linear goal programming; Graphical method and Simplex method, Integer programming: Cutting plane method, Branch and bound method.


Game theory; Two persons zero sum game, Maximin (Minimax) criterion, Games with mixed strategies, graphical solution, Equivalance of the rectangular game and linear programming, solution by simplex method, algebraic method, iterative method, Seating problem of n jobs through two machines, three machines, solution by Gantt chart, Solution by graphical method of processing two jobs through m machines, n jobs through m machines.

Nonlinear programming, Unconstrained problems of maxima & minima, Necessary and sufficient condition for an n variable function to have extreme, Concept of positive definite, extremum Hessian matrix, Newton-Raphson method, Kuhn-Tucker condition for constrained optimization, Quadratic programming, graphical method, Wolfe method.

TEXT / REFERENCES:

MAT540 COMBINATORICS 3.0 0.3


Syllabus - Integrated M Sc (Mathematics/Physics) - 2008 admissions onwards

MAT561 ADVANCED GRAPH THEORY 3.0 0.3

Traversability - Eulerian graphs, Hamiltonian graphs, Line Graphs - Some properties of line graph, Characterization of line graphs, Special line graphs, Line graphs and traversability, Factorization, Planarity - Plane and planar graphs, Euler's formula, Characterizations of planar graphs, Non-planar graphs, Outerplanar graphs, Coloring - the chromatic number, Five color theorem, Matrices - The adjacency matrix, The incidence matrix, The cycle matrix, Groups - The automorphism group of a graph, Operation on Permutation groups, The group of a composite graph, Graphs with a given group, Symmetric graphs, Highly symmetric graphs, Domination Theory - Domination numbers, Some elementary properties.

REFERENCES:
1. R. Haber - Graph Theory, Addition Wesley Reading Mass, 1965.
5. R. Clark and D. A. Holton - A First Look at Graph Theory, Allied publishers.

MAT542 AUTOMATA THEORY 3.0 0.3

SETS, RELATIONS AND LANGUAGES
"If, Then" and its relatives, Sets, Relations and Functions, Special Types of Binary

Syllabus - Integrated M Sc (Mathematics/Physics) - 2008 admissions onwards
Relations, Closures; Finite and Infinite Sets, Three Fundamental proof Techniques, Alphabets and Languages, Finite Representation of Languages.

FINITE AUTOMATA
Deterministic Finite Automata, Nondeterministic finite automata, Equivalence of Deterministic and Nondeterministic Finite Automata, Properties of the Languages accepted by Finite Automata, Finite Automata and Regular Expressions, Proofs that Languages Are and Are not Regular.

CONTEXT-FREE LANGUAGES
Context-free Grammars, Regular Languages and Context-Free Languages, Pushdown Automata,

REFERENCE BOOKS:
2. Hopcroft J. and Ullman J.D., Introduction to Automata Theory, Languages and Computation.

MPJ399 PROJECT 10 cr

During the last semester of the course, each student must undertake a dissertation/project work of ten credits under the supervision of a faculty member of the Department. It can be in any area of Mathematics according to the interest of the student as well as the supervisor. It has two parts: Investigating and understanding a topic, and producing a coherent piece of text that describes the results of the investigation. Both parts are typically new for students, and highly instructive. While studying the topic, the student must work independently, understand texts that may be difficult or short, and possibly solve unfamiliar problems that are not pre-chewed like class-room or textbook exercises. The results of the investigation have to be explained clearly and informatively, in an appropriate tone and style, and in proper form. Writing well is hard work, and an activity that must be learned. The M.Sc dissertation provides such a learning opportunity. Through the dissertation/project work, the student will acquire academic qualifications that enable him/her to take part in modern research and knowledge dissemination.

MPJ397 / MPJ398 SEMINAR 002 1 / 002 1

Seminars shall be given from both the areas of Mathematics and Physics and one credit is awarded together for both in each semester. In this course, students present and discuss the subject matter with faculty guidance. Topics presented by the students include the fundamental topics from both the areas. Also students are exposed to areas of Mathematics and Physics not usually covered in courses and students take turns in giving lectures. The objective of these seminars is to provide the students with training in the verbal and written communication of topics in Mathematics and Physics.

Students interested in exercising the exit option at the end of the 8th semester shall decide on it at the end of the fourth semester. Such students should do an eight credit project with two components viz., (i) Mathematics (ii) Physics of equal number of credits. It can also be from a combined area of Mathematics and Physics. This shall be a 6 credit project for the batches admitted from 2010 onwards and shall be an 8 credit project for 2009 admissions.

The proposed project work shall get started at the beginning of the fifth semester and is to be credited during the sixth semester. The project work should be done under the supervision of faculty members from the respective disciplines. Projects can be something like reading some text books and writing it elaborately or it can be some survey projects and interpretation of results or making working models in Physics etc. At the end of the 5th semester there shall be a review of the ongoing project. Also the student should give a presentation of the project at the end of the sixth semester.

MPJ488 SIMULATION LAB, 003 1

Graph plotting, Simulation experiments etc based - Physics and Mathematics problems - using Matlab/Mathematica

MPJ497 SEMINAR 002 1

Seminars shall be given from both the areas of Mathematics and Physics and one credit is awarded together for both in each semester. In this course, students present and discuss the subject matter, with faculty guidance. Topics presented by the students include the fundamental topics from both the areas. Also students are exposed to areas of Mathematics and Physics not usually covered in courses and students take turns in giving lectures. The objective of these seminars is to provide the students with training in the verbal and written communication of topics in Mathematics and Physics.
PHY110 MECHANICS

Physical quantities, dimensional analysis, kinematics in 1-D, instantaneous velocity and acceleration. Kinematics in 3-D: vector algebra, velocity and acceleration in Cartesian, polar and cylindrical coordinate systems. Circular motion and centripetal acceleration.

Newton's laws and applications: concepts of momentum, energy, angular momentum, work and potential energy. Vibrational motion; conservative forces; contact forces - friction, stress, viscous drag, etc. Pseudo forces and fundamental forces. Mathematical aside: work as a line integral, collisions and conservation laws; potential energy and conservation of energy; Stoke's theorem, curl, rotational force fields.

Frames of Reference: Galilean transformation, absolute and relative velocities, inertial and non-inertial frames, rotating frames, centripetal and coriolis forces; Foucault pendulum.

Rigid body motion, fixed axis rotations, rotation and translation, moments of inertia and products of inertia, principal moments and axes.

Motion under a center force, Kepler's laws. Gravitational law and field, conservative and non-conservative forces, system of particles, center of mass, equations of motion for center of mass and relative motion, elastic and inelastic collision, conservation of linear and angular momentum. Variable mass systems.

Elasticity, Hooke's law and elastic constants of isotropic solid, stress energy. Kinematics of moving fluids, equation of continuity, Euler's equation, Bernoulli's theorem, viscous fluids, surface tension and surface energy, capillarity.

TEXTBOOK:

REFERENCES:
2. Francis W. Sears, Mark W. Zemansky and Hugh D. Young, University Physics (10th edition). Pearson
PHY180

PHYSICS LAB I

List of experiments:
1. Surface Tension - Capillary Rise Method
2. Coefficient of Viscosity - Stokes's Method
3. The Torsion Pendulum
   a. Moment of Inertia of the Disc
   b. The Rigidities Modules of the Material of Wire
4. Young's Modulus - Uniform Bending
5. Spectrometer - Dispersive Power
6. Liquid Lens - Refractive index of liquid
7. Laser - Wave length of Laser beam
8. Laser - SSR Width of the given SSR

PHY181

PHYSICS LAB II

List of experiments:
1. Lee's disc - Thermal Conductivity of a bad conductor.
2. Solar cell characteristics.
3. Potentiometer - Comparison of emfs.
4. Conversion of galvanometer to Voltmeter
5. Field along the axis of a coil.
7. Spectrometer - \( \lambda = \frac{c}{f} \) curve.
8. Newton's rings.
9. Meter bridge - Resistance measurement
10. Ref. index of a Transport bar.
11. Elective field distribution

PHY210

HEAT AND THERMODYNAMICS

Concept of temperature and Zeroth law of thermodynamics - thermometers and temperature scales, thermal expansion of solids and liquids, macroscopic description of an ideal gas, Avogadro number and the Ideal Gas Law. The kinetic theory of gases.


Thermal properties of matter - equations of state, pV/T surface for an ideal gas, real substance, phase diagrams-tripple point and critical point-vapour pressure, the bubble chamber.

State variables - The first law of thermodynamics - energy and work in thermodynamics, work and heat in volume changes, internal energy, Adiabatic process, isothermal processes, isobaric and isochoric processes, throttling processes. Differential form of the first law, internal energy and heat capacity of an ideal gas, Adiabatic expansion of an ideal gas, applications of first law

Heat Engines, internal combustion engine, steam engine. The refrigerator, second law of thermodynamics, reversible and irreversible processes, Carnot's cycle. The Kelvin temperature scale, absolute zero, devices that convert thermal energy to other forms of energy, entropy and its statistical interpretation.

Maxwell's thermodynamic relations and simple applications, Thermodynamic potentials and their application. Phase transitions: Joule-Kelvin effect, first and second law and quasistatic transitions and Clausius-Clapeyron equation, applications of phase transitions to magnetism, superfluidity and superconductivity.

TEXTBOOKS/REFERENCES:
SYLLABUS
Integrated M.Sc (Mathematics/Physics) 2009 admissions onwards

4. Richard P.Feynman, Robert P.Leighton and Matthew Sands, Feynmann Lectures on
5. Brij LAL, N.Subrahmanyan and P.S.Hemmi, Heat, Thermodynamics and Statistical Physics

PHY221
WAVE MOTION AND OPTICS 3104

Review of geometrical optics: Fermat's principle, Laws of reflection and refraction from
Fermat's principle, Refraction at a spherical surface, Linear and lateral
magnifications, Refraction through a thick lens, Focal lengths of thick and thin
lenses. Combination of two lenses. Cardinal points.

Simple Harmonic motion (SHO), differential equation for SHO and its general solution,
superposition of two or more SHOs, Lissajous figures. Damped and forced
oscillators, resonance.

Wave equation, traveling and standing waves in one dimension, energy density and
energy transmission in waves. Group velocity and phase velocity. Sound
waves in media, Doppler effect.

Wave nature of light. Fresnel's equation and its consequences. Spatial and
temporal coherence, interference of light, optical path retardation, Fresnel and
Fraunhofer diffraction, diffraction grating. Rayleigh criterion and resolving power.
Interferometers, optics of multi layer thin films: AR and HR coatings, ray matrix,
optical instruments, Fourier optics.

Polarization: linear, circular, and elliptic polarization, double refraction and optical
totation. Propagation of light through matter, dispersion and absorption, nonlinear
optics, second harmonic generation, integrated optics.

TEXTBOOKS/REFERENCES:
1. Optics - Hecht
2. Introduction to Modern optics by A.K. Ghatak (Tata McGraw Hill)
3. Introduction to Modern Optics - S.O. Fowla
4. Principles of Optics - M. Born and E. Wolf (McMillian)
5. Richard P. Feynman, Robert P. Leighton and Matthew Sands, Feynmann Lectures on

PHY252
PHYSICS OF SEMICONDUCTOR DEVICES 3003

Crystal Structure: Crystal and non crystalline materials, Bravis lattices, crystal
systems, symmetry elements, crystal structures, Miller indices, imperfections.

Electrical Conductivity: Classical Free electron theory of metals, expression for
electrical conductivity, quantum free electron theory of metals, Fermi energy, origin
of bad gap, effective mass.
Semiconductors: Elemental and Compound semiconductors, intrinsic and extrinsic carrier concentration, variation of fermi level with carrier concentration and temperature, Hall effect.

Semiconducting Devices: Photo diodes, PIN diodes, frequency response silicon photo diodes, high speed long wavelength photo diodes.

Quantum Wells, heterojunction semiconductor devices, electro-optic modulators, electro absorption modulators, optical switching and logic ies.

Modern Semiconducting Devices: CCD - Introduction to nano devices, fundamentals of tunneling devices, design considerations, physics of tunneling devices.

TEXTBOOK:

REFERENCES:

PHY260 PHYSICS OF LASERS AND APPLICATIONS 3 0 0 3

Review of some basic concepts and principle of laser


Properties of LASERS
Gain mechanism, Threshold condition for PI (Derivation), Emission broadening-line width, derivation of Dn FWHM Natural emission line width as deduced by quantum mechanics. Additional broadening process: collision broadening, broadening due to dephasing collision, amorphous crystal broadening, Doppler broadening in laser and broadening in gases due to isotope shifts. Saturation intensity of laser, condition to attain saturation intensity

Properties - Coherency, Intensity, directionality, monochromaticity and Focussability.

LASER transition - Role of electrons in LASER transition, levels of LASER action: 2 level, 3 level and 4 level laser system.

Types of LASERS
- Solid State LASER: (i) Ruby LASER - Principle, Construction, working and application.
- Neodymium (Nd) LASERS. Gas LASER: (i) He-Ne LASER - Principle, Construction, working and application.
- CO₂ LASER - Principle, Construction, working and application.

Liquid Chemical and Dye LASERS. Semiconductor LASER: Principle, Characteristics, Semiconductor diode LASERS, homo-junction and hetero-junction LASERS, high power semiconductor diode LASERS.

Applications in Communication field
LASER Communications: Principle, construction, types, modes of propagation, degradation of signal, Analogue communication system, digital transmission, fiber optic communication.

Applications of LASERS in other fields

REFERENCES:

PHY262 INTRODUCTION TO NON-LINEAR DYNAMICS 3 0 0 3

Introduction: examples of dynamical systems, driven damped pendulum, ball on oscillating floor, dripping faucet, chaotic electrical circuits.

One-dimensional maps: the logistic map, bifurcations in the logistic map, fixed points and their stability, other one-dimensional maps.

Non-chaotic multidimensional flows: the logistic differential equation, driven damped harmonic oscillator, Van der Pol equation, numerical solution of differential equations.
Dynamical systems theory: two-dimensional equilibrium and their stability, saddle points, are contraction and expansion, non-chaotic three-dimensional attractors, stability of two-dimensional maps, chaotic dissipative flows.

Lyapunov exponents: for one- and two-dimensional maps and flows, for three-dimensional flows, numerical calculation of largest Lyapunov exponent, Lyapunov exponent spectrum and general characteristics, Kaplan-Yorke dimension, numerical precautions.

Strange attractors: general properties, examples, search methods, probability of chaos and statistical properties of chaos, visualization methods, basins of attraction, structural stability.
Bifurcations: in one-dimensional maps and flows, Hopf bifurcations, homoclinic and heteroclinic bifurcations, crises.

Hamiltonian chaos: Hamilton's equations and properties of Hamiltonian systems, examples, three-dimensional conservative flows, symplectic maps.

Time-series properties: examples, conventional linear methods, a case study, time-delay embeddings.
Nonlinear prediction and noise-reduction: linear predictors, state-space prediction, noise reduction, Lyapunov exponents from experimental data, false nearest neighbors.

Fractals: Cantor sets, curves, trees, gaskets, sponges, landscapes.
Calculations of fractal dimension: similarity, capacity and correlation dimensions, entropy, BDS statistic, minimum mutual information, practical considerations.

Fractal measure and multifractals: convergence of the correlation dimension, multifractals, examples and numerical calculation of generalized dimensions.

Non-chaotic fractal sets: affine transformations, iterated function systems, Mandelbrot and Julia sets.

Spatiotemporal chaos and complexity: examples, cellular automata, coupled map lattices, self-organized criticality.

TEXTBOOK:

REFERENCES:

PHYSICS LAB III

Experiment List
1. Familiarization of devices and equipments
2. Diode Characteristics
3. Rectifiers – Half Wave, Full Wave and Bridge Rectifiers
4. Clipper and Clamper circuits
5. Zener Diode
6. Transistor Characteristics in Common Emitter mode
7. RC Coupled amplifier
8. Oscillators/Multi vibrators
9. Integrator/Differentiator
10. Adder/Subtractor
11. Operational Amplifiers
12. Introduction to Logic Gates

List of experiments
1. Field along the axis of a coil
2. Determine the Cauchy’s constant using Spectrometer
3. Conversion of Galvanometer to Ammeter
4. Measurement of Laser beam divergence
5. Refractive index of transparent bar using diode Laser
6. Stefan – Boltzmann Constant determination
7. Emissivity Measurement
8. Thermal conductivity of Solids
9. Natural Convection heat transfer
10. Moment of Inertia of Disc & Ring
11. Gyroscope couple determination
12. Hartnell Governor - Speed vs sleeve displacement

INTRODUCTION TO ELECTRODYNAMICS

Laws of electrostatics and methods of solving boundary value problems, Multipole expansion of electrostatic potentials, spherical harmonics, Electrostatics in material media, dielectrics, Biot-Savart law, magnetic field and the vector potential, Faraday’s law and time varying fields, Maxwell’s equations, time varying em fields: Poynting vector, conservation laws, propagation of plane electromagnetic waves.

TEXTBOOKS


Syllabi

Integrated MSc Mathematics/Physics
2009 admissions onwards

Schools of Arts and Sciences
AMUKA VISWA VEDAPETHAM
S 42

Schools of Arts and Sciences
AMUKA VISWA VEDAPETHAM
S 43
using X-ray diffraction, point defects, edge and screw dislocations - their notations and concepts, Drude theory of metals, Einstein and Debye theory of specific heats. Free electron theory of metals, Fermi energy and density of states, origin of energy bands, Brillouine zones, concept of holes and effective mass.

Semiconductors, conductivity as a function of temperature, measurement of band gap, doping, Hall effect. Optical properties of semiconductors: direct and indirect band transitions, Auger transitions, excitons, concept of lifetime. Applications of semiconductors as LEDs, Lasers, and solar cells. Introduction to semiconductor crystal growth and processing modern methods of epitaxy. (Brief introduction to quantum wells and super lattices if time permits)

Elemental idea of para, dia, and ferromagnets, Curie's law, super conductivity. Meissner effect, tunneling in super conductors, Josephson junctions, squid, superconducting magnets. Einstein's relations, lifetime and collision broadening in atomic transitions, lasers and their general characteristics, resonant cavities and laser modes. Different types of lasers, their application.

TEXTBOOKS/REFERENCES:

PHYS42 ATOMIC, MOLECULAR AND NUCLEAR PHYSICS 3 1 0 4

Review of atomic structure of hydrogen, atomic structure of two electron system, alkali system, Hartree-Fock method, L-S and jj coupling, molecular binding, LCAO, LCAO, molecular spectra: electronic, rotational and vibrational spectroscopy, Raman effect and Raman spectroscopy, ESR spectroscopy, modern spectroscopic techniques and instruments.

Structure and properties of atomic nucleus, mass and binding energy, nuclear force and nuclear models: liquid drop model and shell model, quadrupole moment, radioactivity and its applications, Law of radioactive decay, elements of nuclear reactors, Fission and Fusion, modern experimental tools of pure and applied nuclear physics, NMR spectroscopy, fundamental forces, elementary particles, quarks and leptons.

TEXTBOOKS/REFERENCES:
1. Principles of Lasers and their Application
2. Introduction to Atmospheric Science
3. Physics of Universe
4. Order and Chaos
5. Special & General Relativity
6. Statistical Mechanics
7. Condensed Matter Physics
8. Physics of Information Processing

**PHY343 MATHEMATICAL ASPECTS OF MECHANICS 3 0 0 3**

Basics: Art of estimation and approximations, the concept of scaling, dimensional analysis and the nature of functional relationship among physical quantities as imposed by their dimensions (units).

Second order differential equations, linear and non-linear, with initial conditions and applications to motion in one dimension: changes, rates, graphs of motions; mathematical statement of Newton's laws; mathematical models of some forces in nature - gravitational, electrostatic, frictional, spring forces and forces that occur in constrained motion; inhomogeneous differential equations and applications to forced and damped periodic motions.

First integral invariant and integral of motion; concepts of kinetic energy, work, potential and potential energy, conservation of mechanical energy, and power; phase-space description of motion: phase-space trajectories, flows, separatrices, and elementary stability theory.

Mathematics of motion of system of particles: center-of-mass coordinates and center-of-mass frame; models of contact forces, impulses and collisions; integral invariants and conservation of momentum.

Vector calculus and motion in 2 and 3 dimensions: trajectories in Cartesian, cylindrical and spherical polar coordinates; models of forces in 3 dimensions; vector fields - rotational, irrotational and conservative vector fields; Gauss divergence theorem and fields is a continuous distribution of matter, scalar fields and potentials; symmetry, cyclic coordinates and conservation laws; spherically symmetric force fields: inverse square and linear forces; integral invariants: energy, angular momentum, Laplace-Runge-Lenz vector.

Rotating coordinate systems and the rigid body motion: pure rotations, moment-of-inertia-tensor, combined translation and rotation, instantaneous axis of rotation, Chasles' theorem, Euler's equations.

Some mathematical aspects of the Special Theory of Relativity.

**PHY400 EXPERIMENTAL TECHNIQUES 4 0 0 4**

Vacuum techniques: Production and measurement of vacuum, different types of vacuum systems and gauges, Electronics: Measurement techniques in electronics, use of different measuring devices, Power supplies amplifiers, pulse techniques and high frequency techniques, Detectors: Study of different types of detectors, photographic detectors, microwave detectors, X-ray detectors and nuclear radiation detectors.

Structure and multi-structure analysis by X-rays and electron diffraction, transmission and scanning electron microscopy technique, Study of molecular structure by resonance techniques like NMR, FTNMR, and ESIR, IR, FTIR, and Raman spectrosopies, Study of electronic structure by Photoelectron spectroscopy, and X-ray absorption techniques, Study of surface morphology by structure by STM and AFM, Study of magnetic thin films by Ferromagnetic resonance, vibrating sample and torque magnetometry and magnetic force microscopy.

(If time permits the following may be included)
Work experience: Design and fabrication of simple pieces of equipments required in the Physics laboratory.

**REFERENCES:**
1. Spectroscopy (3 volumes): Herzberg
2. Spectroscopy - Banerji
3. Atomic and molecular Spectroscopy - G Ananthas

**PHY410 CLASSICAL MECHANICS 4 0 0 4**

Newton's Laws - Newton's Laws, Free Fall, G-force - both qualitative & quantitative, Mechanics of a system of particles in vector form, Conservation of
linear momentum, energy and angular momentum. Degrees of freedom, Principle of virtual work, D’Alembert’s principle including generalized coordinates and velocities, Lagrangian action principle, external action, Euler-Lagrange equations, Constraints, Applications of Lagrangian formalism, Generalized momenta, Hamiltonian, Hamilton’s equations of motion, Phase space, Central forces & Kepler problem, bound and scattering motions, Scattering in a central potential, scattering cross section, Non- inertial frames of reference and pseudoforces - centrifugal, Coriolis and Euler forces, Elements of rigid-body dynamics, Euler angles – The symmetric top, Small oscillations, Normal mode analysis, Elementary ideas on general dynamical systems – conservative versus dissipative systems, Hamiltonian systems and Liouville’s theorem, Canonical transformations, Poisson brackets, Action-angle variables.

TEXTBOOKS/REFERENCES:

PHY430 ADVANCED ELECTRODYNAMICS 4 0 0 4

Review of Electrostatics: Gauss’ Law and its applications; Laplace and Poisson equations, boundary value problems; Magnetostatics: Biot-Savart law, Ampere’s theorem;
Electromagnetic induction; Maxwell’s equations in free space and linear isotropic media; boundary conditions on fields at interfaces; Scalar and vector potentials; Gauge invariance;
Electromagnetic waves in free space, dielectrics, and conductors; Reflection and refraction, polarizations, Fresnel’s Law, interference, coherence, and diffraction; Dispersion relations in plasma; Lorentz invariance of Maxwell’s equations;
Transmission lines and wave guides: Dynamics of charged particles in static and uniform electromagnetic fields; Radiation from moving charges, dipoles and retarded potentials.

TEXTBOOKS:
1. Introduction to Electrodynamics – Griffith
2. Electrodynamics – Jackson
3. Electromagnetics – Landau
4. Classical Electrodynamics – Greiner

PHY431 QUANTUM MECHANICS II 4 0 0 4

Time independent perturbation theory, non-degenerate and degenerate cases. Fine and hyperfine structure of energy levels. Stark and Zeeman effects.

Time dependent perturbation theory and Fermi’s Golden Rule; Selection rules; Semi-classical theory of radiation; Variational method; WKB approximation.
Elementary theory of scattering, phase shifts, partial waves, Born approximation; Identical particles, Pauli’s exclusion principle, spin-statistics connection;
Relativistic quantum mechanics: Klein Gordon and Dirac equations.

TEXTBOOKS/REFERENCES:
1. Quantum Mechanics - Landau and Lifshitz, Butterworths
3. Quantum Mechanics - E. Merzbacher, Wiley
4. Quantum Mechanics – Griffith
5. Quantum Mechanics – Greiner
6. Quantum Mechanics – Thirwall

PHY432 MATHEMATICAL PHYSICS 3 0 0 3

Introduction to theoretical foundations of classical and modern physics - Includes calculus of vector fields, linear algebra - Finite and infinite dimensional linear spaces, Infinite dimensional spaces. Generalized functions, and elementary tensor calculus, Infinite Series, Fourier series, ODEs, Special functions, Probability.
TEXTBOOKS:

   Chapters: 1, 2, 3, 4, 6, 8, 11, 12, 14, 16
2. Mathematics for Scientists, Denney & Krzywicki. Dover, 1996. (Chapters 2, 3, 4)
3. Special Functions by W. G. Bickley, Dover, 2004
5. Mathematical methods of Physics, Mathews & Walker, 2004 (Chapters 1-3)

PHY433 ADVANCED MATHEMATICAL PHYSICS

Functions of a complex variable, Fourier & Laplace Transforms, PDEs, Green's functions, Integral representations, Calculus of variations - Functionals, Lagrange multipliers, Group theory - Elements of group theory, Discrete groups with examples. Continuous groups (Lie groups) (rotation group in 2 and 3 dimensions, U(1) and SU(2)). Generators, Representations.

TEXTBOOKS:

2. Mathematics for Physicists, Demoney & Krzywicki. Dover, 1996. (Supplemented as and when required)

PHY450 FUNDAMENTALS OF PLASMA PHYSICS

(Pre-requisites: Good academic standing, PHY 321 & PHY 420, and Instructor approval)

Spatial scale of an unmagnetized plasma – Debye Length, time scale – plasma period, gyroradius and gyrofrequency of magnetized plasma, single particle motion in prescribed fields – E x B, q x B. Curvature, and polarization drifts, magnetic moment, adiabatic invariants of particle motion, magnetic mirror, two-fluid description of plasmas, electrostatic and electromagnetic waves, Instabilities, one fluid and MHD equations, MHD waves, Alfven waves, Vlasov description of collisionless plasmas, electrostatic waves & Landau damping, MHD discontinuities.

TEXTBOOKS:


PHY451 SPACE PHYSICS

Pre-requisites: Good academic standing, PHY 321, PHY 420, preferably PHY450 & Instructor Approval

Brief history of solar-terrestrial physics – The variable Sun and the heliosphere, Earth’s space environment and upper atmosphere; space plasma physics – single particle motion, plasma state, Fluid description, MHD & Kinetic theory, Applications; solar wind & Interplanetary Magnetic Field (IMF), shocks and instabilities in space; Solar Wind interactions with magnetized planets – Introduction, planetary magnetic fields, spherical harmonic expansions, geomagnetic field and its measurements, variations in Earth’s field, SW-magnetosphere interaction, magnetospheric dynamics; ionospheres, currents in space and ionosphere, dynamics of neutral atmosphere.

TEXTBOOKS:

1. Kiepenheuer & Rusch, Introduction to Space Physics, CUP, 1995
4. Blamthorn, W., & Tsurutani, B., Basic Space Plasma Physics, Imperial College Press, 1997
5. Other excellent supplementary texts on space plasmas and introductory books on neutral atmosphere.

PHY452 NONLINEAR DYNAMICS

(Pre-requisite: PHY252)

Typical examples of nonlinearities in vibration and wave phenomena; phase space, dissipative versus conservative systems, attractors, basins of attraction, elementary bifurcation theory, linear stability theory, Poincare sections and maps, strange attractors, Hamiltonian Chaos, Time series properties, Lyapunov exponents, transition scenarios (Feigenbaum, Ruelle-Takens, and intermittency), universality, synchronization, fractal, fractal dimensions, and analysis of time series by embedding.

Applications of nonlinear dynamics to different disciplines; ecology, engineering, neurobiology, and fluid dynamics.

Propagation of nonlinear pulses and the nonlinear Schroedinger equation, the Korteweg-de Vries equation, solitons; nonlinear wave interactions; forced nonlinear waves; examples and applications.

TEXTBOOKS/REFERENCES:


Schools of Arts and Sciences
3. Chaos and nonlinear dynamics, 2s, OUP:2000

**OPTOELECTRONICS 3003**


**TEXTBOOKS & REFERENCES:**

**INTRODUCTION TO NANOPHYSICS AND APPLICATIONS 3003**

Introduction: the relation of Physics to other Sciences - Introduction - Chemistry - Biology - Astronomy - Geology - Psychology - How did it get the way?

Basic properties and measuring methods of nanoparticles: Size effect and properties of Nanoparticles - Particle size - Particle shape - Particle density - Melting point, surface tension, wettability - Specific surface area and pore - Composite structure - Crystal structure - Surface characteristics - Mechanical property - Electrical properties - Magnetic properties - Optical property of nanoparticle.

Synthesize and Characterization: Classification of fabrication methods - Top to bottom approach - bottom to top approach - physical and chemical methods - CVD, Controlled precipitation, solgel method, PLD, etc. X-ray diffraction - introduction - basic principles - characterization by XRD - examples of XRD characterization - Debye Scherer formula - FTIR - introduction - basic principles - methodologies and accessories - interferometers and standards. Scanning electron microscopy - basics and primary modes of operation - applications - Transmission electron microscopy - basic principles - Scanning tunneling microscopy - basic principles - common modes of analysis and examples - sample requirements - artifacts - Atomic force microscopy - introduction - basic principle - modes of operation - applications. Photoluminescence - basic principles - Spectroscopic Ellipsometry - basic principles - Applications - Raman Spectroscopy - basics principles.

**REFERENCES:**

**PHYSICS LAB A & B 003 1 / 003 1**

Michelson's interferometer, Millikan's oil drop experiment, Photovoltaic effect, Anderson bridge, compressibility of liquid (ultrasonic), Corrosus Fringes, Newton's law of cooling, Susceptibility by Gouy's method, Faraday effect - Verdet constant, Hall effect, Hysteresis of wire and rod, photo electric effect, bending loss in an optical fiber, emission spectra, absorption spectra of Iodine and KMnO4, thin film deposition, GM Counter, ABBE's Refractometer, some superconductivity experiments...etc

**TEXTBOOKS:**
1. Advanced Practical Physics - Workmap & Files
2. Laser Experiments - Siroh

**SEMINAR I / SEMINAR II 002 1 / 002 1**

The aim of the seminar course is to train students give technical presentations. The topics for presentation are chosen by the teacher and these may include the topics in the area of student's project work.

**MINI PROJECT 1 cr**

The aim of the mini project work is to give first exposure to the student for research methodology. This can include literature survey, review, data collection and theoretical/experimental work on small parts of research in area chosen by the faculty guiding the mini project work.
**PHYS10  STATISTICAL MECHANICS  4 0 0 4**

Systems with a very large number of degrees of freedom: the need for statistical mechanics, micro- and macrostates; Phase space, Liouville’s theorem, ergodicity, fundamental postulates; probability theory; review of thermodynamics, thermodynamic potentials; microcanonical ensemble, connection with thermodynamics.

Canonical ensemble: partition function, free Energy and connection with thermodynamic quantities; classical ideal gas; Maxwell-Boltzmann distribution, equipartition theorem.

Quantum statistics; grand-canonical ensemble; ideal Fermi and Bose gases, photons and phonons; blackbody radiation, Planck’s distribution law; Bose-Einstein condensation.


Introduction to non-equilibrium processes: Brownian motion, diffusion, Fokker-Planck equation.

**TEXTBOOKS/REFERENCES:**

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**PHYS40  NUCLEAR AND PARTICLE PHYSICS  4 0 0 4**


Elementary particles (quarks, baryons, mesons, leptons); Spin and parity assignments, isospin, strangeness; Gell-Mann-Nishijima formula; C, P, and T invariance and applications of symmetry arguments to particle reactions, parity non-conservation in weak interaction; Relativistic kinematics.

**REFERENCES:**

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**PHYS51  CONDENSED MATTER PHYSICS I  3 0 0 3**


Crystalline solids: Bravais lattices. Diffraction of waves by crystals; structure factor; Bragg’s law in direct and reciprocal lattices. Brillouin zones. Crystal systems: point groups, space groups; crystal symmetry and modification; physical property tensors.

Free electron theory of metals: thermal and electrical conductivity, Hartree-Landau, electronic specific heat, inadequacy of the theory.
Electrons in periodic potentials: Bloch wavefunctions, nearly free electron model, energy bands and gaps, Brillouin zones, Fermi surface; conductors, insulators, and semimetals; effective mass, concept of holes. Tight binding model: examples. Band structure calculations: an overview; energy spectrum of selected solids.

Electron transport: wavepackets in crystals, semiclassical dynamics in electric and magnetic fields; cyclotron resonances, Landau levels, de-Hass van Alphen oscillations; quantum adiabatic phase (optional topic); anomalous and quantum Hall-effects.

Semiconductors: energy band structure, intrinsic and extrinsic semiconductors, electrical conductivity, p-n junction, Schottky-barrier.

REFERENCES:
2. Itcho and Luth, Solid State Physics, 3rd Ed., Springer India.
4. C. Kittel, Introduction to Solid State Physics, 7th Ed., Wiley India.

TEXTBOOK/REFERENCE:

Elementary of electron-electron interaction: Hartree-Fock equations, correlation, screening; Introduction to Fermi liquid theory.

Lattice vibrations: monoclinic and diatomic lattices, elastic and optical phonons, Debye theory of lattice specific heat; thermal conductivity; Umklapp processese; neutron scattering. Phonons in metals: electron-phonon interaction, effective electron-electron interaction.

Dielectrics: Macroscopic electrostatic Maxwell’s equations, local field, screening, Clausius-Mosotti equation, polarization and adiabatic phase, optical properties of ionic crystals, polaron.

Magnetism in solids: para-, dia-, ferro- and anti-ferro magnetism, mechanisms, spin waves, colossal magnetoresistance, overview of spin transport and spin electronics.

Super conductivity: Meissner effect, London’s equations, BCS theory, Ginzburg-Landau theory, flux quantization, Josephson effects; application: SQUID.

Introduction to physics of materials at nanoscale: size-dependent optical and electrical properties, overview of selected nanomaterials and nanodevices.

REFERENCES:
4. C. Kittel, Introduction to Solid State Physics, 7th Ed., Wiley India.
### Unit 2: Random Variables, Discrete and Continuous Distributions
- Uniform, Binomial, Poisson, Exponential, Gamma and Normal Distributions.
- Function of Random variables.
- Mathematical Expectations, Variance, Moments, Moment generating functions - Characteristic function (definition only), Chebychev's Inequality.

### Unit 3: Jointly Distributed Random Variables
- Joint, Marginal and Conditional Probability Distributions.
- Transformation of Random Variables.
- Sequences of random variables, law of Large numbers, Central Limit Theorem.
- Sampling Distributions of Sample Mean, and Sample Variance, Student's T and F Distributions.

### Unit 4: Theory of Estimation
- Point and Interval Estimation Methods.
- Testing of Hypothesis, Large and Small Sample Tests for Mean, Variance and Proportion.
- Goodness of Fit, Testing of Independence and Homogeneity.
- Correlation and Regression: Scatter diagram, Principle of least squares, curve fitting, regression lines and coefficient of correlation, Rank correlation.

### Textbooks:

### STA430 PROBABILITY THEORY

**Axioms of Probability, Conditional Probability and Independence, Random variables and distribution functions, Random vectors and joint distributions, Functions of random vectors, Expectation, moment generating functions and characteristic functions, Conditional expectation and distribution, Modes of convergence, Weak and strong laws of large numbers, Central limit theorem.**

### Textbook/References:

### STA431 STOCHASTIC PROCESSES

**Definition and classification of general stochastic processes, Examples, Markov chains, Transition probability matrices, classification of states, recurrence, examples, Basic Limit theorems of Markov chains, Renewal Equation (Discrete case), Absorption probabilities, random walk and queuing examples. Continuous time markov chains, pure birth processes, poisson processes, birth and death processes, differential equation of birth and death processes, examples. Renewal processes, renewal equations and elementary renewal theorem, Brownian motion, continuity of paths and the maximum variables, variations and extensions.**

### Textbook/References:

### STA432 STATISTICAL INFERENCES

**A brief review of probability, random variables, mathematical expectation and special probability distributions, Sampling distributions, and order statistics. Decision theory - The theory of games, statistical games, decision criteria, the minimax criterion and the base criterion. Estimation theory - Unbiased estimators, efficiency, consistency, sufficiency, robustness, the method of moments, the method of maximum likelihood and Bayesian estimation and estimation applications. Hypothesis testing - Testing a statistical hypothesis, losses and risks, Neyman-Pearson lemma, the power function of a test, likelihood ratio tests and applications. Regression and correlation - Linear regression, method of least squares, normal regression and correlation analysis and multiple linear regression. The general linear hypothesis, the regression model, one way and two way analysis of variance. Non parametric tests - the sign tests, signed rank test, the U-test, the t-test.**

### Textbook/References: