REGULATIONS & SYLLABUS

CURRICULA

for

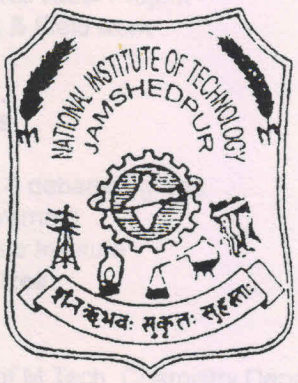
M. Tech. Course

राष्ट्रीय प्रौद्योगिकी संस्थान, जमशेदपुर

NATIONAL INSTITUTE OF TECHNOLOGY

(A DEEMED UNIVERSITY)
JAMSHEDPUR, JHARKHAND
INDIA

CURRICULA
for
M.Tech. Course



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(A DEEMED UNIVERSITY)
JAMSHEDPUR, JHARKHAND
INDIA

2004

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RULES RELATING TO 4 – SEMESTER POSTGRADUATE PROGRAMS LEADING TO THE DEGREES OF MASTER OF TECHNOLOGY

1. Introduction

Provisions of these regulations shall come into force with immediate effect and shall be applicable to all Postgraduate courses leading to the degrees of Master of Technology (M.Tech.).

The departments and centres as listed in *Appendix - I* shall offer the Master's degree programs under these regulations in such areas as the Senate may decide from time to time.

Duration and Academic Calendar

The postgraduate programs shall be of duration of 24 months spread over four semesters mentioned below, and the schedule of events in the semesters, i.e. the date of commencement, mid – semester and end – semester examinations etc. shall be laid down by the Senate every year in the Academic calendar :

First (Autumn) Semester -	July to December
Second (Spring) Semester -	January to April
Third Semester -	May to December
Fourth Semester -	January to June

A student admitted to the program will be required to complete successfully the four semesters at a stretch. However, sponsored students and regular students may be given permission to complete the program as per provisions given in under special circumstances.

2. Admission

2.1 Students with scholarship

Admission to the Postgraduate program will be granted in the Autumn Semester of each year on the basis of the performance at (i) a common all – India competitive test known as Graduate Aptitude Test in Engineering (GATE). The admissions will be made in order of merit based on valid GATE score. The GATE score certificate can be used for one time admission only.

2.2 Self financed students

A limited number of self – financing candidates may be granted admission in Autumn semester of each year as laid down in para 2.1

2.3 Sponsored students

Candidate who are employed in recognized organizations shall be eligible for admission as sponsored candidate to any of the postgraduate courses. The conditions and requirements for admission as a sponsored candidate are laid down separately in *Appendix - II*

2.4 Foreign nationals

Eligible foreign nationals who have either (i) been selected for award of Government scholarship/ fellowship or (ii) been permitted by the Government of India to undergo studies as self – financing foreign student may also be admitted to any of the courses.

However, those foreign nationals/non – resident Indians who passed the qualifying degree examinations (B.Tech., B.Arch., M.Sc or an equivalent degree, as the case may be) from an Indian University/ Institute and are desirous of admission to any of the courses either with Government of India scholarship/ fellowship or as a self – financing foreign student shall be required to qualify in GATE/NET.

2.5 Permanent staff members of the Institute

Permanent non – teaching staff members of the Institute shall be eligible for admission to the M.Tech. programs subject to (i) prior permission being obtained from Deputy Director, the appropriate authority, and (ii) fulfillment of the minimum prescribed qualifications. They will however have to appear for an interview before the DAC (PG & R) of the Department/Centre. The condition governing such permission are given in Appendix – VI.

The Institute reserves the right to cancel the admission of any student and ask him/her to discontinue the studies at any stage of the program either due to unsatisfactory academic performance or unsatisfactory attendance in classes or indiscipline.

2.6 If the number of students admitted in the session to any particular course is less than the minimum number fixed by the Senate the course will not be offered in that session. The students admitted thereto will be required to change over to another course offered by the Institute for which they may be otherwise eligible. In such circumstances, however, the candidates may withdraw their candidature and will be entitled to a full refund of fees paid.

The Senate may review rules regarding admission, from time to time.

3. Residence

The Institute is full residential and all students shall be required to reside in and be a member of the Hall of Residence to which they are assigned at the time of admission.

Detailed rules regarding residence requirements are given in *Appendix – III.*

4. Attendance

Attendance in all classes of the subjects registered for (Lecture, Laboratories/Practical, Workshop, Seminar etc.) is compulsory. If the attendance of any student in any subject (s) is considered to be unsatisfactory the student's registration in the concerned subject (s) will be cancelled and the students may be asked to discontinue.

A student shall be entitled to the following types of leave during the academic year counted from the date of commencement of the session concerned as prescribed in the Academic Calendar of the Institute.

Sl. No.	Leave in a year	Max. no. of Days	Sanctioning authority
i)	Casual leave	15	Head of the Department/Centre
ii)	Medical leave	10	Head of the Department/Centre, provided that the application is supported by a certificate from the Institute Doctor or a Doctor recognized by the Institute for the purpose

N.B. i) Leave not availed of by a student in the first year shall not accumulate.
The concerned Department/Centre will maintain the leave record.
If a student is absent without permission for more than one month his/her name will be remove from roll.
An M.Tech. student is not entitled to any vacation on account of inter – semester break, summer and winter vacations.

Any absence over and above the prescribed limit of admissible leave shall entail deduction from the scholarship, besides other action as may be decided by the Institute.

5. Conduct and Discipline

Students shall conduct themselves within and outside the precincts of the Institute in a manner befitting the students of an institution of national importance.

6. Course Structure

Weightage of the courses shall be reckoned in credits, as specified against each subject.

In order to qualify for a M.Tech. degree of the Institute, a student is required to complete between 80 and 86 credits as required by the prescribed curricula of the department/centre concerned.

The credits that have to be completed satisfactorily for the degree are distributed as follows :

		No. of credits
(ii)	First and second semester together	
(a)	Theory courses	34 - 40
(b)	Seminar	02
(c)	Laboratories	06 - 08
(d)	Comprehensive Viva Voce	03
	Total	45 - 51
(ii)	Third semester : Thesis Part – I	15
(iii)	Fourth semester : Thesis Part – II	20
TOTAL (of the course)		**80 – 86 credits**

Course structure

Credit loading for 1st and 2nd semester and its distribution

Total credits for theory, laboratory and seminars during 1st and 2nd semester, which would be inclusive of 1 compulsory subject from each of the following groups (3 credits).

Humanities and Social Science/Management

Information Technology/Computer applications

Distribution of courses during first and second semesters :

(a) First semester

No. of theory courses	5
No. of seminar class	1
No. of laboratories	2

(b) Second semester

No. of theory subjects	5
No. of seminar class	1
No. of laboratories	1
Comprehensive viva	1

Course pattern and credits :

	Pattern	Credits
Theory subjects	3 – 0 – 0	3
	3 – 1 – 0	4
Laboratory	0 – 0 – 3	2
Workshop/Laboratory	0 – 0 – 6	4
Seminar	0 – 0 – 2	1

A student is required to qualify separately in each of the components (i), (ii), (iii) of para 6 and all sub – components of 1(a) & (b) listed above. The third semester CGPA shall be computed after taking into account the grades obtained in the Comprehensive viva – voce examination held during the summer term, preferably in the first fortnight in month of May.

The curriculum for a course shall comprise core and elective subjects. The core subjects may constitute a maximum of one – half of the curricular requirement. The list of elective subjects may include subjects from allied disciplines also.

7. Comprehensive Viva Voce, Industrial Training/Minor Project and Project Work

Comprehensive Viva Voce : A comprehensive viva voce will ordinarily be held in the summer term, immediately after end of second semester in the month of May. The oral examination will carry 3 credits and cover the entire course of study during the first and second semester. The viva voce will be conducted by a Board consisting of member from the faculty of the Department/Centre. The grade obtained in the viva voce shall be used for computing the SGPA at the end of the 3rd semester.

The Head of the Department/Centre may invite a member of faculty from an allied Department/Centre to be associated with the conduct of the comprehensive viva voce.

Project work :

A student will start working on the project immediately after the second semester ends (middle of May). They will carry out their project work in the third and fourth semesters. The project carries a total of 35 credits with 15 credits being assigned to third semester and 20 credits during fourth semester.

A student shall carry out the project work under the supervision of a member of the teaching staff and/or a Scientific Officer of the Institute.

A student may undertake to execute the project in collaboration with an Industry, Research and Development Organization or another academic institution/University where sufficient facilities exist to carry out the project work, In addition to the Supervisor from the Department/Centre a Joint Supervisor may be appointed from the Industry, a Research Laboratory or another University with the approval of the Departmental Academic Committee (PG & R). The Joint Supervisor will be associated with guidance and may also be associated with evaluation of the performance of the student. The internal Supervisor may, if felt necessary, visit the Industry, or the Research Laboratory or the University in India in connection with the project of a student.

For purpose of assessment, the performance of a student in the project work may be divided into the following parts :

Third semester :

The student shall have to submit a report of the work done during the Semester and present a seminar lecture of 20 – 25 minutes duration (followed by a discussion) to the members of the project assessment committee formed (inclusive of the co – supervisor), by the Department/Centre by 31st December.

The grades shall be assigned on the basis of marks awarded in the following manner :

On project work to be given by the Supervisor	50 %
On report and seminar lecture by the Project Assessment Committee	50 %

Fourth semester :

The student shall submit a synopsis by 31st April and deliver a seminar lecture of 20 – 25 minutes duration before the project assessment committee by 15th May. The co – supervisor shall also be a member of the committee.

The student shall submit the thesis latest by 30th June subject to having passed the synopsis seminar. The student will have to appear at a viva – voce and deliver a lecture of 20 – 25 minute's duration. The dissertation seminar and viva – voce shall be conducted by the last date fixed as per the academic calendar fixed by the Senate. The grades shall be assigned on the basis of marks awarded in the following manner :

Project work to be awarded by the supervisor	40 %
Synopsis and seminar lecture marks awarded by the Project Assessment Committee	10 %
Dissertation to be awarded by the external examiner	25 %
Viva voce marks to be awarded by the external examiner	25 %

A student has to have a satisfactory performance in each component separately to qualify for the degree.

Project work : Assessment will involve the day – to – day work of the student for the project. The project supervisor(s) will periodically review the student's progress over the period and finally give an assessment of the work done by the student.

Synopsis Seminar : A student shall be required to present a synopsis of the work and deliver a seminar talk of 20 – 25 minute's duration in the 4th semester as per the time table fixed by Senate. The Seminar shall be assessed by a Committee constituted by the DAC (PG&R) for the purpose. The student will be allowed to submit the thesis subject to satisfactory defence of the synopsis. If the synopsis seminar is not found satisfactory the student will have to do more work as suggested by the Project Assessment Committee. The student shall thereafter deliver another seminar lecture within

one month. The project assessment committee shall be at liberty to extend the duration of the project work by a maximum period of 3 months should they find that the level of work done has not been satisfactory. The synopsis shall be sent to the external examiner to obtain his/her concurrence for examination of the thesis.

Dissertation and viva – voce : A student shall be required to submit a dissertation on the Project Work carried out by him/her. Three/four bound copies of the thesis will be submitted to the Head of Department/Centre by the last date prescribed in the Academic Calendar for the purpose. A brief bio – date and a one page abstract of the project work carried out will be required to be appended to the dissertation.

The thesis will be sent to the external examiner, appointed by the appropriate authority, from a panel of experts suggested by the Department/Centre, by the first week of July for examination.

Dissertation viva voce will be held by the date fixed in the Academic Calendar. The external expert who examined the thesis will conduct the viva voce. In the cases of students who are required to do the project work over an extended period and submit dissertation at a later date, an expert form an allied Department/Centre within the Institute may be associated with the assessment of dissertation and conduct of viva – voce.

Extension of project work beyond the submission deadline in very special cases may be granted by the Dean (PGS) on recommendation of the Department/Centre for a maximum period of 3 months. The viva voce will have to be completed within the extension period. The student shall not be eligible either for award of scholarship during the extension period or any medal or prize. However, if the student had been absent on medical grounds and his/her project had been extended, he/she will be eligible for award of medal or prize.

Project in collaboration with industry

A student may, with the approval of the Head of the Department/Centre, do the project work with an Industry, a Research and Development Organization or another academic Institute/University. The student shall acknowledge the involvement and/or contribution of an industry, R & D organization or University in completing the project in the dissertation and an certificate to this effect, issued by the supervisor from the industrial organization, will be appended to it.

It is mandatory of all students (specially those who do their project in an industry, R & D organization or University in India or abroad) to make a full disclosure of all data on which they wish to base their thesis. They cannot claim confidentiality simply as it would come into conflict with the Industry's R & D laboratory's or other University's own interests. Any tangible intellectual property other than copyright of thesis may have to be assigned to the Institute; the copyright of the thesis itself would however lie with the student as per the IPR policy in force at the time. The student's thesis shall be rejected unless there is full and complete disclosure of data and the student will not be eligible for M.Tech. degree of the Institute in such cases.

8. Registration

All students of the M.Tech. courses are to register for the required credits at the commencement of each of the four semesters and summer term, on the day announced for such registration.

The Head of the Departments/Centres concerned shall organize the registration of the students.

A student who is unable to register on the date fixed for registration can be permitted to register late by not later than 3 working days with the permission of the Head of the Department/Centre and payment of late registration fee as applicable at that time. A student may be permitted late registration by not later than 10 calendar days subject to approval of Dean (PGS) and on payment of late registration fee.

Only those students will be permitted to register who have

1. Made all required advance payments of Institute tuition fee, seat rent etc. and
2. Cleared hall dues for the current semester for which they are registering.
3. Cleared all Institute and Hall dues of the previous semester
4. Has maintained the SGPA/CGPA requirement during the earlier semester(s) as mentioned in 11.4

A student may be allowed to become non – resident on the recommendation of the Faculty Adviser and the Head of the Department/Centre and with the approval of the Dean of Postgraduate Studies after successful and continuous completion of the full course work (theory/laboratory/seminar/workshop/comprehensive viva – voce etc.) with a CGPA = 6.0 and no failure. The withdrawing student shall have to complete the project work, submit the thesis and appear at the final viva – voce within 5 years of admission. No student shall be allowed to become non – resident during the third and the fourth semester.

Sponsored students and those who opt to become non – resident in order to join service will either have to produce a letter from their employer stating that they can carry out the project work at the employing organization or rejoin the department/centre to work on the project full time at a later date if the employing organization does not have the facility for execution of the project work.

Provided further that :

- The student communicates in writing to the Head of the Department/Centre by the end of preceding June the intention to submit the dissertation.
- Before submission of the dissertation the student delivers a Seminar talk on a date to be fixed by the Head of the Department/Centre, clears all outstanding dues, if any, to the Institute or to the Hall of Residence.
- The student has to pay the semester registration fee for third and fourth semesters and re – submission fee as may be prescribed by the Institute from time to time.
- The assessment of the dissertation and the conduct of the viva voce thereon will be arranged by the Head of the Department/Centre along with other regular students of the particular semester.

Students who discontinue their studies without prior permission before completing the first/second semester course work shall be deemed to have abandoned their studies and their names will be struck off the rolls of the Institute with effect from the date of absenting from the classes. A student who leaves the Institute without prior permission even during the 3rd or 4th semester shall also be treated to have discontinued and will be liable to similar action.

A student who has already registered may register for a new subject in addition to the subjects he/she has already registered for, or opt for a new subject in place of the one already registered for, with the concurrence of the Faculty Advisor and the HOD/HOC.

Any change of subject as permissible as stated above must however, be done within one week of registration.

9 Grading System

A Seven – scale letter grade system will be used to assess the performance of students in the various categories (subject, project, etc.) as follows

Description	Letter – grade	Grade points per Credit
Excellent	Ex	10
Very good	A	9
Good	B	8
Fair	C	7
Average	D	6
Pass	P	5
Fail	F	2

In addition, there shall be two transitional symbols used by Examiners -

I – for Incomplete
X – for Debarred

A Semester Grade Point Average (SGPA) will be computed for each Semester to work out the overall performance of a student in that semester. The SGPA will be calculated as follows :

$$SGPA = \frac{1}{\sum_{i=1}^{n} C_i} \times \sum_{i=1}^{n} C_i g_i$$

Where : n is the number of subjects registered for during the Semester,
C_i is the number of Credits allotted to a particular subject and
g_i is the grade of points corresponding to the grade awarded for that subject.

A Cumulative Grade Point Average (CGPA) will be computed at the end of the Second and the Project semesters.

$$CGPA = \frac{1}{\sum_{i=1}^{m} C_i} \times \sum_{i=1}^{m} C_i g_i$$

The CGPA gives the cumulative performance of the students from the first semester up to the end of the semester to which it refers, and will be calculated as follows :

Where : 'm' is the number of subjects registered for semester 1 onwards up to the current semester.

Both SGPA and CGPA will be rounded off to the second place of decimal and recorded as such. Whenever these Grade Point Averages are to be used for the purpose of determining the *inter se* merit ranking of a group of student, only the rounded off values will be taken into account.

When a students gets grade 'I' or grade 'X' for any subject(s) during a semester. the SGPA for that semester and the CGPA will be tentatively calculated ignoring this subject. After the 'I' or 'X' grade has been replaced by a completed grade, the SGPA for that semester and the CGPA will finally be recalculated taking into account the performance in the subject(s) concerned.

When a student gets grade 'F' for any subject(s) during the semester, the SGPA and CGPA from that semester onwards will be tentatively calculated, taking only '2 points' for each such grade during that semester. After the F grade(s) has been substituted by a higher grade in the supplementary examination or in a subsequent semester, the SGPA and CGPA of all the semesters. onwards from the semesters in which 'F' grade was obtained earlier, will be suitably modified to take this change of grade into account.

10. Awarding of Grades

There will be continuous assessment of a student's performance through the semester and grades will be awarded by the teacher concerned or by the appropriate committees appointed for the purpose on the basis of following:

Mid - semester and end-semester examination in the case of theoretical subjects, comprehensive viva voce, laboratory/design/workshop, project, seminars, dissertation and viva voce.

In the case of theoretical subjects :

The concerned Department/Centre will conduct the mid – semester and end semester examinations

For theoretical subject, the final grades will be awarded on the basis of Teacher's assessment, Mid - Semester Examination and End – Semester Examination according to the Weightage given below :

Teacher's Assessment (attendance, home assignment assignments, class test, tutorials etc.)	**Mid – Semester examination**	**End – Semester examination**
20	30	50

The final grades for a subject must be submitted to – the Head of the Department/Centre by the teacher concerned within FIVE DAYS of the date on which the Semester Examination for that subject has been held.

For subjects like laboratory/design/drawing/workshop etc. the evaluation will be based on the Weightage as shown below :

Day – to – day work (Attendance and completion of practical / laboratory / drawing / tasks assigned)	**At least 2 oral / practical / drawing / tests and / or viva - voce**
60	40

A Seminar Assessment Committee will be formed by the Heads of the Departments/Centres for the evaluation of performance at Seminars. Every student who registers for 'Seminar' is expected to attend all the seminars of all the students of the batch held in the Department/Centre during the Semester, Due Weightage will be given to a student's attendance in the overall evaluation of this requirement.

Viva Voce Boards will be constituted by the Head of the Department/Centre for conducting the comprehensive viva voce which will normally be conducted in May. The viva shall be assessed either by the DAC (PG&R) of the Department/Centre or by a committee constituted by the DAC (PG&R) for the purpose.

In converting the percentage of marks obtained by the students to letter grades the following grading system will be used. The numerical score awarded shall correspond to a letter grade according to the following table.

% of Numerical marks	*Grade*
90 % and above	Ex
80 % or above but less than 90 %	A
70 % or above but less than 80 %	B
60 % or above but less than 70 %	C
50 % or above but less than 60 %	D
35 % or above but less than 50 % (Theory)	P
40 % or above but less than 50 % (Seminar/Laboratory, Project)	P
Below 35 % (Theory)	F
Below 40 % (Seminar/Laboratory, Project)	F

11. Examinations

11.1 In keeping with the policy of continuous assessment, in the case of theoretical subjects, there will be a mid – semester examination in about the middle of the Semester and an End – semester examination at the end of the semester. Normally, there will be no end – semester examination in the practical (i.e. Laboratory, Workshop etc.). However, if any – test or final examination in Laboratory/Drawing/Workshop is held, its Weightage should conform to Para 10.

11.2 Students will be permitted to appear in the examinations of only those subjects for which they have registered themselves in the beginning of a semester.

11.3 The semester examination will carry specified Weightage for the purpose of award of grades for subjects of various L – T - P loading.

11.4 A student will be required to discontinue studies if the SGPA/CGPA computed at the end of any semester falls below 6.0,even after taking into consideration the results of the supplementary examination.

11.5 The Institute scholarship of a student will be withheld in case a student fails in any subject. It will be restored only if SGPA/CGPA is at least 6.0 and there is no F grade following the supplementary examination. The student may however, continue without scholarship after supplementary examination with F grade/grades conditions to 11.4

A student can appear for supplementary examinations in the subject(s) concerned to be held in the Department/Centre within 1 month after the completion of the semester. In supplementary examination the student will be given one grade lower than the actual performance grade except in the case of grade 'P' which will remain unchanged. The student will apply in a prescribed form together with necessary fees in order to appear in the supplementary examinations.

Students with F grades also have an option to re – register for the subject(s) in which they had failed in the following Autumn Semester or Spring Semester. In such a case they will be entitled to full credit according to performance at the examination.

A student whose performance in any of the parts of the project work as prescribed in Para 7. has been unsatisfactory, may be assigned additional work on the same problem or assigned a new problem. If the student is assigned additional work the student will have to complete the work and appear at the viva – voce in July as per the academic calendar fixed by the Senate. If the student is assigned a new problem on account of any reason, the student will have to submit the dissertation and complete the viva – voce by October 31 of that calendar year. The student shall not be eligible for scholarship during the extended period of his stay but will have to pay project semester fees during the extended period of stay.

A student who has failed in the comprehensive viva – voce shall be required to present himself/ herself again within a period of two months for the viva – voce on a date to be fixed by the Head of the Department/Centre. The student will be entitled to award of one grade lower than the actual performance in such cases. The student has to discontinue studies in the event of failing second time.

12. The 'Incomplete' Grade 'I' and debarred grade "X"

12.1 The grade 'I' may be temporarily given to a student who is unable to appear in the end – semester examination because of :

- Illness or accident which disables the student from appearing in the examination. This must be duly certified by the Medical Officer of the Institute or a Doctor recognized for the purpose.
- A calamity in the family at the time of the examination which, in the opinion of the Head of the Department/Centre and Dean of Students Affairs required the student to be away from the campus.

If a student is unable to appear at a mid – semester examination for any of the compelling reasons mentioned above, the teacher(s) concerned may use discretion, and take a test with same Weightage.

12.2 A student who has been awarded grade 'I' in a subject in the end – semester examination shall have the option to either,

- appear at a supplementary examination to be held by the Department by filling in the application in prescribed form together with payment of necessary fees. In the supplementary examination the student will be awarded one grade lower than the actual grade obtained from the performance in the examination, except in the case of grade 'P' which will remain unchanged.

or

- re – register for the subject in the subsequent semester in which it is offered. In such case the student is entitled to full credit in accordance with the performance. No supplementary examination will be held in laboratory subjects. The student has to re – register during a regular semester.

12.3 Debarred grade "X"

A student who is absent for a major part of a semester, or does not complete a major part of the laboratory/design/workshop/seminar work etc. or does not appear in the mid – semester without any acceptable ground will be debarred from appearing at the end – semester examination.

A student who is debarred from appearing at an end-semester examination for reasons as specified by Para 11.3 will be required to re-register for the subject(s) in the next semester when they are offered by the Department/Centre, subject to other conditions of the regulations.

13. Graduation Requirements

In order to qualify for either M.Tech. degree of Institute, a student must-

- Have completed all the credit requirements for the degree, which is prescribed to be a minimum of 80 credits, with grade 'P' or a higher grade in each of the subjects etc for which the student registered in the three semesters.
- Have obtained a CGPA of 6.00 or more at the end of the semester in which the student completes all the requirements (including the dissertation), for the degree.

A student will be declared to have qualified for the degree in a session if the student completes all the requirements covering a minimum of 80 credits by the 30th July when the session is closed, and will be admitted to the degree in the next annual convocation.

A student who has qualified for the degree will be admitted to it only after the student has cleared all Institute and Hall dues, if any, outstanding against the student, has returned all library books borrowed by the student and also returned instruments, Department/Centre's library books etc in good condition.

14. Withdrawal

A student who has been admitted to M.Tech. program may be permitted to withdraw temporarily for a period a one semester or more from the Institute on account of prolonged illness/acute problem in the family provided that :

- The student applies to the Institute within 15 days of commencement of the semester or from the date last attended the classes stating fully the reasons for such withdrawal to together with supporting documents and endorsement of the father/guardian.
- The Institute is satisfied that, inclusive of the period of withdrawal, the student is likely to complete on the requirements for the degree within 5 years of admission to the program
- There are no outstanding dues or demands from the Institute/Department/Centre/Hall of Residence/Library.

A student who has been granted temporary withdrawal will be required to pay tuition fee and other fees for the current semester registration when the student rejoins the program A student shall be granted only one such temporary withdrawal during the program.

15. Scholarships & Prizes

The Institute shall award Postgraduate Scholarships in accordance with the provisions laid down in the rules at *Appendix – V.*

16. Relaxation

The Senate may, under exceptional circumstances, consider any case of a student having a minor deficiency in respect of any of the requirements stated in these regulations and relax the relevant provision of these regulations based on the merit of the case. The grounds on which such relaxation is granted shall invariably be recorded and cannot be cited as precedence.

APPENDIX - I

LIST OF DEPARTMENTS AND CENTRES OFFERING 4 – SEMESTER POSTGRADUATE PROGRAMS LEADING M.TECH. DEGREES

(See para 1 of the Regulations)

Name of the Department/Centre	M.Tech. Degree
Chemistry	
Civil Engineering	
Computer Science & Engineering	
Electrical Engineering	

Electronics Engineering
Production Engineering & Management
Mechanical Engineering
Metallurgical Engineering and Materials Science

APPENDIX -II

RULES REGARDING ADMISSION OF SPONSORED CANDIDATES TO POSTGRADUATE COURSES

(See para 2.3 of the Regulations)

The Institute may admit persons, who are in gainful employment as 'Sponsored Students' to any of the courses covered by this regulation subject to the condition laid down in following paragraphs.
An applicant seeking admission as a sponsored candidate must have obtained at the qualifying degree examination -

- at least 60 % marks or equivalent CGPA in the case of Bachelor's degree examination in Engineering, Technology or architecture and Master's degree examination in a Science subject, and
- a minimum of 55 % marks or equivalent CGPA if the student passed master's degree examination in Arts or Social Science subject.

Candidates who possess the minimum prescribed qualification and are in service in any of the following establishments shall be eligible for admission to the courses as sponsored students -

- Defense or other ministries of the Govt. of India or any other Government organization
- Established industries, Research and Development Organization as may be recognized by the Institute from time to time.
- Autonomous public undertakings
- QIP Scheme of the Govt. of India
- Universities and recognized technical institutions which are not covered by the QIP Scheme

Candidates seeking admission as sponsored students must have had a standing of at least 2 years service and while applying, shall have to produce evidence to the effect that (a) they are on leave to study with full pay for the duration of the course and (b) their services in the establishments concerned will be retained.

Intending sponsored candidates must submit their application on prescribed form for admission through their employers, a competent authority of which will forward the same to the Institute with suitable endorsements as required by the form, so as to reach the Institute by the stipulated date

In the case of a sponsored candidate the maximum age limit of 35 years.

All sponsored candidate shall be required to qualify in an interview by a selection committee to be appointed by the Departmental Academic Committee (PG&R) of the Department/Centre concerned The provisions of this Para shall not be applicable to the candidates selected for admission under Defense sponsorship of the Govt. of India.

A sponsored candidate selected for admission shall be required. at the time of joining the Institute. to

- Produce certificate in a prescribed form from the employers to the effect that the applicant
- Has been in service there for at least a period of 2 years.
- Has been officially released from duties for purpose of joining the course and Services are retained with the employers.
- Submit evidence of having passed the qualifying examinations with required percentage of marks or grade and such other documents as the Institute may require

APPENDIX - III

RULES RELATING TO RESIDENCE REQUIREMENTS

(See para 3 of the Regulations)

The following are the detailed rules governing residence requirements of students :

The mess of each Hall of Residence shall function as a single integrated unit and shall not, under any circumstances, be sub – divided into any kind of groups or sub – groups.

Under special circumstances, the Director/Dean Academic Affairs may permit a student to reside with the parent/guardian in the Institute Campus or within a reasonable distance from the Institute. Such a student shall, however be attached to a Hall of Residence and will be required to pay seat rent according to rules, and Hall establishment charges fixed by the Warden. However, this permission may be withdrawn at,the discretion of the Institute, at any time considered appropriate by it, without assigning any reason.

Family accommodation may be provided to married students (Sponsored, QIP, Foreign nationals with Government Scholarship) of M.Tech. courses, if available

A student shall reside in a room allotted to him/her and may shift to any other room only under the direction/permission of the Warden.

No student shall come into or give up residence in any Hall of Residence without the prior permission of the Warden.

Students shall be required to make their rooms available whenever required for repairs, maintenance disinfection, or inspection and shall be required to vacate the rooms when leaving for the vacations/ holidays.

Students shall be responsible for the proper care of the furniture, fan and other fittings in the rooms allotted to them and shall generally assist the Warden in ensuring proper use, care and security of those provided in the Halls for common use of all students.

Students will be responsible for the safe keeping of their own property. In the event of loss of the personal property of student due to theft, fire of any other causes, the Institute shall accept no responsibility and shall not be liable for payment of any compensation.

All students must abide by the rules and regulations of the Hall of Residence as may be framed from time to time.

Use of electrical appliances like heaters, and cooking inside the rooms are strictly prohibited. Engaging personal attendants and keeping pets by a student in the Hall of Residence are debarred.

A Student who has been permitted to withdraw temporarily from the program must vacate the Hall of Residence, on the day of departure. Suitable accommodation may be re – allotted when the student rejoins the program

APPENDIX - IV

RULES REGARDING CONDUCT AND DISCIPLINE

(See Para 5 of the Regulations)

Following rules shall be applicable to all students in the matters of conduct and discipline

1 Students shall show due respect to the teachers of the Institute, the Wardens of the Halls of residence, the Sports Officers of the Gymkhana and the Officers of the NSS; proper courtesy and consideration should be extended to the employees of the Institute and of the Halls of residence. They shall also

pay due attention and courtesy to visitors.

2. Students are required to develop a friendly camaraderie with fellow students. In particular, they are expected to show kindness and consideration to the new students admitted to the Institute every year. Law bans ragging of new comers in any form. Acts of ragging will be considered as gross indiscipline and will be severely dealt with.

3. The following acts of omission and/or commission shall constitute gross violation of the code of conduct and are liable to invoke disciplinary measured

- Ragging
- Lack of courtesy and decorum; indecent behavior any where within or outside the campus.
- Willful damage or stealthy removal of any property/belongings of the Institute/Hall or of fellow students
- Possession, consumption or distribution of alcoholic drinks or any kind of hallucinogenic drug.
- Adoption of unfair means in the examinations
- Mutilation or unauthorized possession of library books
- Noisy and unseemly behavior, disturbing studies of fellow – students.

Commensurate with the gravity of the offence, the punishment may be reprimand, fine, expulsion from the Hall, debarment from an examination, rustication for a specified period or even outright expulsion from the Institute.

4. For an offence committed in (a) a Hall of Residence, (b) the Department or in a class room and (c) elsewhere, the Warden, the Head of the Department and the Dean of Student's Affairs, respectively. shall have the authority to reprimand or impose fine or take any other suitable measure.

All cases involving punishment other than reprimand shall be reported to the Chairman of the Standing Institute Conduct and Disciplinary Committee

5 (a). All major acts of indiscipline, which may have serious implication on the general body of the students, and/or which may warrant a uniform and more formalized nature of investigation, shall be handled by the Standing Institute Conduct and Disciplinary Committee, appointed by the Senate

The Standing Institute Conduct and Disciplinary Committee consists of the following ex – officio and other member

(1)	Dean of Students' Affairs	Chairman
(2)	President, Technology Students' Gymkhana	Member
(3)	Coordinating Warden	Member
(4) and (5)	Two Senate nominees	Member
(6)	Vice President, Students' Gymkhana	Member
(7) and (8)	Two Hall President, by rotation	Members

Additionally, the Warden(s) and the President(s) of the Hall(s) to which the involved student(s) belong(s) are co – opted as members of the committee.

5 (b) Recommendations of the committee which include the suggested quantum of punishment in cases of proven guilt, are communicated to the Director who, as Chairman of the Senate awards any punishment after giving a hearing to the student(s) concerned and subsequently reported to the Senate.

6. Cases of adoption of unfair means in an examination shall be dealt with by the Head of the Departments/ Centre concerned in consultation with the invigilators and the Paper – Setter.

The Head of the Department shall recommend appropriate measures in each case to the Director who as Chairman of the Senate shall award the punishment and later report the mater to the Senate.

7 (i). The Head of the Department/Centre may debar a student from appearing in an examination on any of the following grounds, if the student's.

- attendance in the lecture/tutorial/practical/workshop/design/seminar classes during the semester has been unsatisfactory,

- performance in the laboratory/workshop/design etc. work done during the semester has not been satisfactory;
- conduct in the classes or in the Department/Centre has been unsatisfactory or the student has attempted to adopt unfair means at the examination;

7 (ii). A student may also be debarred from appearing at an examination if there is a written report from the Warden of the Hall of Residence to the effect that the student -

- has not cleared the outstanding dues in the Hall;
- has been involved in an act of misconduct or indiscipline;

APPENDIX - V

TERMS AND CONDITIONS FOR AWARD OF INSTITUTE POSTGRADUATE SCHOLARSHIPS

(See para 15 of the Regulations)

1. Institute Postgraduate Scholarships

All students admitted to any of the M.Tech. courses under section 2.1 of this Regulation shall be entitled to Institute Postgraduate Scholarships

- Provided that the first installment of scholarship shall be released only after satisfactory scrutiny of necessary documents supporting the students' eligibility for the scholarship. The students will have to submit all documents by October 31 of the session.
- The monthly value of the scholarship shall be as approved by the Board of Governors from time to time with the prior sanction of the Government of India.
- The Scholarship shall be tenable for a maximum period of 24 months subject to the provisions appearing hereinafter.
- The award of a scholarship shall be made, in the first instance, for 12 months of the session (July to June following) and will remain valid till the month of next June provided the student maintains the requirement of attendance, conduct and discipline etc.
- The scholarship shall be released in the beginning only after the admission of a student has been confirmed on verification of all necessary testimonials and the student has been reported medically fit by the Institute Doctor/Hospital authorized to do so by the Institute.

Notwithstanding the provisions of the foregoing subparagraphs the scholarship for the first month shall be payable on pro – rata basis depending on the date of joining of a student.

The last monthly installment of scholarship for the 24th month shall be payable in full irrespective of the date of final Viva Voce of the project Semester, held in that month; In the case of a student who discontinues studies before completing the program, the scholarship shall be payable up to the date the student attends the classes or works in the Department/Centre.

A student who was permitted, after having successfully completed the course work barring the project work, to leave the Institute for purpose of joining services may be re – awarded the scholarship for the remaining part of the tenure of 24 months; provided that -

- the student submits on re – joining, and application for the resumption of scholarship enclosing a certificate of 'No Objection' from the employers. The student shall not draw any salary from the employer during continuance of the fellowship.

Such application shall be granted at the discretion of the Institute on the basis of merit of the case.

In the event of a student being absent from the Department/Centre without obtaining prior permission/ sanction there for and/or if the period of absence exceeds the limit of admissible leave as prescribed by para 4 of the rules, deductions may be made from the student's monthly installment of scholarship proportionately.

A student shall be required to abide by all instructions issued by the Institute from time to time concerning award/payment of scholarship.

No student shall be permitted to enjoy more than one scholarship or remuneration form any other source during the same period. In the event of an awardee becoming eligible for another scholarship

from the Institute or any other source, the student will have the option to retain any of the awards according to the choice. In such a case the student will communicate the choice in writing to the Dean of Post – Graduate Studies.

A student who has been admitted to the program as a sponsored candidate may also apply for, and be awarded and the discretion of the Dean of Postgraduate Students, Institute Postgraduate scholarship subject of the condition that the student -

- possesses B.Tech. or equivalent degree, or has qualified at GATE and has a valid GATE score percentile not blow the cut – off point of admission of regular students in the session for the Department/Centre concerned.
- Produce a certificate of 'No Objection' from the employer.
- And there is a vacancy in sanctioned strength of the Department/Centre.

APPENDIX - VI

RULES RELATING TO ENROLMENT OF NON – TEACHING STAFF MEMBERSS

(See para 2.5 of the Regulation)

Permanent members of non – teaching staff of the Institute may be permitted to join the M.Tech. program of the Institute provided that prior permission has been obtained from competent authority before applying for admission to the program.

For admission to the program a member of staff must have obtained at least the percentage of marks/ grade/CGPA as prescribed to be the minimum requirement for sponsored candidates.

All common rules laid down in the M.Tech. regulations relating to course work, project work under the supervision of a member of faculty, etc. unless permitted otherwise, shall be applicable to such persons.

A member of staff enrolled for the M.Tech. degree shall be required to pay registration fee only, as applicable from time to time. Members of staff permitted and enrolled for the degree shall not be entitled to any Scholarship.

The other condition for granting permission to the non – teaching staff to enroll in the M.Tech. program shall be as follows.

The applicant must hold a permanent post in the Institute and must have standing of at least 3 years service in the post.

The application for administrative permission to join the M.Tech. program by a member of non – teaching staff must be submitted through the Head of the Department/Centre or the Section in – charge, as the case may be. While submitting the application the applicant must give an undertaking in the form appended hereto (Schedule – A) to the effect that the applicant will abide by all rules and regulations.

The maximum number of credits that can be taken by the employee in each semester shall be at the convenience of the Department/Centre. If the exigencies of Institute work so require, the permission granted can be withdrawn by the Institute at any time. The employee shall complete the entire coursework and project over a minimum period of 4 years and within a maximum period of 5 years.

All applications under this category shall be examined by the Post Graduate Program and Evaluation Committee taking into account whether the proposal for joining the program for which permission is sought for arises out of genuine interest and ability. After the permission is granted the person will submit application for admission together with the prescribed fee. The minimum period to be spent for completion of the course work and submission of the dissertation by the candidates shall be 3 years from the date of registration. The maximum period however remain to be 5 years.

A member of the non – teaching staff who has obtained a M.Tech. degree from the Institute under this clause shall have to serve the Institute for a period a 3 years after obtaining the degree.

SCHEDULE - A

UNDERTAKING

I, Mr./Ms..... Member of the non – teaching staff holding a permanent post of ..... at the National Institute of Technology, Jamshedpur, do hereby give the undertaking that I shall abide by the rules and regulations as may be laid down by the Senate of the Institute from time to time for undergoing the M.Tech. program.

I also undertake hereby that since I shall be on duty while undertaking the program of study I shall ensure that all normal official duties assigned to me are executed without any handicap.

I further understand that the permission granted to me for joining the program can be withdrawn at any time if the exigencies of official duties so require or if it causes breach of any of the provisions of rules and regulations.

Date : .....

.....

(Signature)

COURSE STRUCTURE
Chemistry Department
M.Tech in Surface Science & Engineering

SEMESTER - I

Sl. No.	Subject Code	Course Name	L-T-P	Credits
1.	CH41101	Surface Science & Engineering Practices	3-1-0	4
2.	CH41102	Electrochemistry of Electrified Interfaces	3-1-0	4
3.	CH41103	Physical Metallurgy & High Temperature Oxidation	3-1-0	4
4.	CH41104	Corrosion Engineering & Materials	3-1-0	4
5.	MH41101	Numerical Methods & Computational Technique	3-1-0	4
6.	MH41201	NMCT Lab	0-0-3	2
7.	CH41201	Surface Engineering Lab	0-0-3	2
8.	CH41301	Seminar	0-0-2	1
		TOTAL	15-5-8	25

SEMESTER - II

Sl. No.	Subject Code	Course Name	L-T-P	Credits
1.	CH42101	Mechanistic Models of Corrosion/ Passivation & Fracture	3-1-0	4
2.	CH42102	Corrosion testing/ Evaluation & Pollution Aspects	3-1-0	4
3.	CH42103	Corrosion Protection & Design	3-1-0	4
4.	CH42104	Paint Technology	3-1-0	4
5.	GE42101	Personnel Management & Industrial Relations	3-1-0	4
6.	CH42202	Electrochemistry Lab	0-0-3	2
7.	CH42302	Seminar	0-0-2	1
		TOTAL	15-5-5	23

SEMESTER - III

Sl. No.	Subject Code	Course Name	L-T-P	Credits
1.	CH43401	Project (I)		15
2.	CH43501	Comprehensive Viva- voce		3
		TOTAL		18

SEMESTER - IV

Sl. No.	Subject Code	Course Name	L-T-P	Credits
1.	CH44402	Project (II)		20
		TOTAL		20

Total Credits of four Semesters = 86

Department of Electrical Engineering
M.Tech in Power System

SEMESTER – I

Sl. No.	Subject Code	Course Name	L-T-P	Credits
1.	EE41101	Computer Methods in Power System	3-1-0	4
2.	EE41102	Control System	3-1-0	4
3.	EE41103	Generalized theory of Machines	3-1-0	4
4.	EE41104	Introduction to Microprocessor & its Applications	3-1-0	4
5.	CA41101	Optimization Technique	3-0-0	3
6.	EE41201	Electrical M/c & Power System Lab	0-0-3	2
7.	EE41202	Microprocessor Applications Lab	0-0-3	2
8.	EE41301	Seminar	0-0-2	1
		TOTAL	15-5-8	24

SEMESTER - II

Sl. No.	Subject Code	Course Name	L-T-P	Credits
1.	EE42105	Thyristor Circuit & its Applications	3-1-0	4
2.	EE42106	Power System Stability	3-1-0	4
3.	EE42107	Power System Protection	3-1-0	4
4.	EE42108	Power System Transient	3-1-0	4
5.	GE42101	Personal Management & Industrial Relations	3-0-0	3
6.	EE42203	Relay Lab	0-0-3	2
7.	EE42302	Seminar	0-0-2	1
		TOTAL	15-5-5	22

SEMESTER - III

Sl. No.	Subject Code	Course Name	L-T-P	Credits
1.	EE43401	Project (I)		15
2.	EE43501	Comprehensive Viva- voce		3
		TOTAL		18

SEMESTER - IV

Sl. No.	Subject Code	Course Name	L-T-P	Credits
1.	EE44402	Project (II)		20
		TOTAL		20

Total Credits of four Semesters = 84

Mechanical Engineering Department
M.Tech. in Computer Integrated Design and Manufacturing (CIDM)

SEMESTER – I

Sl. No.	Subject Code	Course Name	L-T-P	Credits
1.	ME41101	Analysis and Dynamics of Mechanism	3-1-0	4
2.	ME41102	Advance Mechanics of Solids	3-1-0	4
3.	ME41103	Numerical Methods	3-1-0	4
4.	ME41104	Programming in High Level Language	3-1-0	4
5.	ME41105	System Optimization and Management	3-1-0	4
6.	ME41201	Computational Laboratory	0-0-3	2
7.	ME41202	CIDM Lab I	0-0-3	2
8.	ME41301	Seminar I	0-0-2	1
		TOTAL	15-5-8	25

SEMESTER - II

Sl. No.	Subject Code	Course Name	L-T-P	Credits
1.	ME42106	Artificial Intelligence and Robotics	3-1-0	4
2.	ME42107	Computer Aided design	3-1-0	4
3.	ME42108	Computer Aided Manufacturing	3-1-0	4
4.	ME42109	Computer Graphics	3-1-0	4
5.	ME42110	Finite Element Methods	3-1-0	4
6.	ME42203	CIDM Lab II	0-0-3	2
7.	ME42302	Seminar II	0-0-2	1
		TOTAL	15-5-5	23

SEMESTER - III

Sl. No.	Subject Code	Course Name	L-T-P	Credits
1.	ME43501	Comprehensive Viva voce		3
2.	ME43401	Thesis Part I	0-0-15	15
		TOTAL	0-0-15	18

SEMESTER - IV

Sl. No.	Subject Code	Course Name	L-T-P	Credits
1.	ME44402	Thesis Part II	0-0-20	20
		TOTAL	0-0-20	20

Total Credits of four semesters = 86

Met. Engg. And Mat Science Department
M. Tech Course in Extractive Metallurgy (Iron & Steel)

SEMESTER – I

Sl. No.	Subject Code	Course Name	L-T-P	Credits
1.	MT41101	Met. Thermodynamics & Kinetics	3-1-0	4
2.	MT41102	Iron making	3-1-0	4
3.	MT41103	Transport phenomena	3-1-0	4
4.	MT41104	NMCT	3-1-0	4
5.	MT41201	Met. Lab I	0-0-3	2
6.	MH41201	NMCT Lab	0-0-3	2
7.	MT41202	Seminar	0-0-2	1
		TOTAL	15-5-8	21

SEMESTER – II

Sl. No.	Subject Code	Course Name	L-T-P	Credits
1.	MT42101	Pneumatic Steel making	3-1-0	4
2.	MT42102	Electric Steel making	3-1-0	4
3.	MT42103	Secondary Steel making	3-1-0	4
4.	MT42104	Quality Control & Finishing of Steel	3-1-0	4
5.	MT42105	Energy & Materials Management	3-1-0	4
6.	MT42201	Met. Lab II	0-0-3	2
7.	MT42202	Seminar	0-0-2	1
8.	MT41203	Industrial Training (6 weeks)		4
		TOTAL	15-5-5	27

SEMESTER - III

Sl. No.	Subject Code	Course Name	L-T-P	Credits
1.	MT43401	Thesis Part I	0-0-15	15
2.	MT43501	Comprehensive Viva voce		3
		TOTAL	0-0-15	18

SEMESTER - IV

Sl. No.	Subject Code	Course Name	L-T-P	Credits
1.	MT44402	Thesis Part II	0-0-20	20
		TOTAL	0-0-20	20

Total Credits of four semesters = 86

M.Tech. Course in foundry Technology

SEMESTER – I

Sl. No.	Subject Code	Course Name	L-T-P	Credits
1.	MT41101	Met. Thermodynamics & Kinetics	3-1-0	4
2.	MT41105	Solidification of metals & alloys	3-1-0	4
3.	MT41103	Transport phenomena	3-1-0	4
4.	MT41104	NMCT	3-1-0	4
5.	MT41201	Met. Lab I	0-0-3	2
6.	MT41201	NMCT Lab	0-0-3	2
7.	MT41202	Seminar	0-0-3	2
		TOTAL	12-4-9	22

SEMESTER – II

Sl. No.	Subject Code	Course Name	L-T-P	Credits
1.	MT42106	Metal melting Technology	3-1-0	4
2.	MT42107	Structure and properties of cast metal	3-1-0	4
3.	MT42108	Foundry Tech. I	3-1-0	4
4.	MT42109	Foundry Tech. II	3-1-0	4
5.	MT42110	Quality Control of casting	3-1-0	4
6.	MT42204	Foundry Lab	0-0-3	2
7.	MT42202	Seminar	0-0-2	1
8.	MT41203	Industrial Training (6 weeks)		4
		TOTAL	15-5-5	27

SEMESTER - III

Sl. No.	Subject Code	Course Name	L-T-P	Credits
1.	MT43402	Thesis Part I	0-0-15	15
2.	MT43502	Comprehensive Viva voce		3
		TOTAL	0-0-15	18

SEMESTER - IV

Sl. No.	Subject Code	Course Name	L-T-P	Credits
1.	MT44403	Thesis Part II	0-0-20	20
		TOTAL	0-0-20	20

Total Credits of four semesters = 86

Computer Applications Department

MASTER OF COMPUTER APPLICATIONS
MCA – (Six Semester) Course

SEMESTER – I

Sl. No.	Subject Code	Course Name	L-T-P	Credits
1.	CA31101	Foundation of Information Technology	3-1-0	4
2.	CA31102	Computer Organisation and Architecture	3-1-0	4
3.	MH31101	Mathematics for Computer Science	3-0-0	3
4.	MH31102	Probability & Statistical Computing	3-1-0	4
5.	CA31103	Programming and Data Structures	3-1-0	4
6.	CA31104	Optimization Techniques	3-1-0	4
7.	CA31201	FIT & Statistical Computing Lab.	0-0-3	2
8.	CA31202	Programming & Data Structure Lab.	0-0-3	2
		TOTAL	18-5-6	27

SEMESTER – II

Sl. No.	Subject Code	Course Name	L-T-P	Credits
1.	CA32105	Interactive Computer Graphics & Multimedia	3-1-0	4
2.	CA32106	Object Oriented Technology using C++	3-1-0	4
3.	MH32103	Numerical Computation	3-1-0	4
4.	CA32107	Graph Theory and Network flows	3-1-0	4
5.	CA32108	Operating Systems	3-1-0	4
6.	GE32101	Marketing Management	3-0-0	3
7.	CA32203	Optimization Techniques Lab.	0-0-3	2
8.	CA32204	Object Oriented Programming Lab.	0-0-3	2
		TOTAL	18-5-6	27

SEMESTER – III

Sl. No.	Subject Code	Course Name	L-T-P	Credits
1.	CA33109	System Analysis & Design	3-0-0	3
2.	GE33102	Operations Management	3-1-0	4
3.	CA33110	Data Base Management Systems	3-1-0	4
4.	CA33111	Computer Communication and Network	3-1-0	4
5.	CA33112	Parallel and Distributed Processing	3-1-0	4
6.	CA33113	Elective – I	3-1-0	4
7.	CA33205	Data Base Management Lab.	0-0-3	2
8.	CA33206	Operating System & Network Lab.	0-0-3	2
		TOTAL	18-5-6	27

SEMESTER – IV

Sl. No.	Subject Code	Course Name	L-T-P	Credits
1	GE34103	Financial Management	3-1-0	4
2	CA34114	System Simulation & Modelling	3-1-0	4
3.	CA34115	Internet and Web Technology	3-1-0	4
4.	CA34116	Software Engg. – I	3-1-0	4
5.	CA34117	Decision Support Systems	3-0-0	3
6.	CA34118	Elective – II	3-1-0	4
7.	CA34207	Web Technology Lab.	0-0-3	2
8.	CA34208	DSS & Simulation Lab.	0-0-3	2
		TOTAL	18-5-6	27

SEMESTER – V

Sl. No.	Subject Code	Course Name	L-T-P	Credits
1.	GE35104	Organizational Behaviour and Human Resource Management	3-0-0	3
2.	CA35119	Software Engg. – II	3-1-0	4
3.	CA35120	Network Programming	3-1-0	4
4.	CA35121	Artificial Intelligence and Applications	3-1-0	4
5.	CA35122	Data Warehousing & Data Mining	3-1-0	4
6.	CA35123	Elective – III	3-1-0	4
7.	CA35209	CASE Tools & AI Lab.	0-0-3	2
8.	CA35301	Seminar/Colloquium/Comprehensive Viva	0-0-3	2
		TOTAL	18-5-6	27

SEMESTER - VI

Sl. No.	Subject Code	Course Name	L-T-P	Credits
1.	CA36401	Thesis/Project	0-0-25	25
		TOTAL	0-0-25	25

Total Credits of four semesters = 160

LIST OF ELECTIVES

1) Design & Analysis of Algorithm,
2) Compiler Design
3) Image Processing
4) UNIX and Shell Programming
5) Client / Server Technology
6) Microprocessors & their Interfacing
7) Computer Aided Design
8) Enterprise Resource Planning
9) Neural Networks and Soft Computing
10) Supply Chain Management
11) E. Business & E-Commerce
12) Industrial Robotics and Automation
13) Advanced Optimization Techniques
14) Pattern Recognition
15) Advanced Computer Architecture
16) Network Security
17) Digital Signal Processing
18) Managerial Economics
19) Embedded Systems
20) Wireless Communications and Mobile Compu
21) Formal Language & Automata Theory
22) Fault Tolerant Computing
23) Advanced Data Model
24) Customer Relation Management
25) Human-Computer Interface
26) Geographical Information System

SYLLABUS
Chemistry Department
M.Tech. in Surface Science & Engineering

CH41101: SURFACE SCIENCE AND ENGINEERING PRACTICES (3-1-0)

1] Capillarity: Surface Tension and surface free energy; Young Laplace equation and experime
Treatment of capillary rise, exact solution of capillary rise problem, Experimental aspects of capil
rise:(a) Maximum bubble pressure method, (b) Drop weight method (Detachment Technology)
Ring method (du Nuoy method), (d) Wilhelmy slide method, (e) Pendant drop method, (f) Static dr
Hanging bubble and sessile bubble method, (g) Rotating drop method, (h) Oscillation in jet meth
(i) Capillary wave

2] Thermodynamics of liquid interfaces
Surface thermodynamic quantities; Structural treatment of liquid interfaces; Surface tension in bin
solution, Surface excess, Derivation of Gibbs equation of surface excess, Determination of surfa
excess, Gibbs monolayer, Two dimensional ideal gas law; Spreading of liquid; Kinetics of spread

3] State of monomolecular film :(a) Gases film, (b) Gas – Liquid transition, (c) Condensed phases
Solid state, (e) Monolayer collapse; Mixed film; Contact angle at solid – liquid interface; Contact ang
hysteresis; Experimental methods for measurement of contact angles
Theories of contact angle phenomena: -(a) Thermodynamics of Young's equation, (b) Semi-empir
model by G-G-F-Y equation, (c) Potential - Distortion model
Wetting as a contact angle phenomena, Wetting as a capillary action phenomena, Water repellen
Floatation; Micelle formation and properties of micelles

4] Rheological characteristics; Theories of viscosity
Rheological measurements: -(a) Co-axial cylinder viscometer, (b) Cone plate viscometer, (c) Capill
flow viscometer, (d) Falling sphere viscometer, (e) Efflux viscometer

5] Friction between lubricated surfaces: (a) Boundary lubrication, (b) Mechanism – Hardy's mod
Bowden-Tabor model
Adhesion:(a) Ideal adhesion, Work of adhesion, (b) Practical adhesion (Griffith-Irwin criteria)

6] Adsorption of gas on solids
Chemisorption: Molecular view, Work function, Kinetics of desorption

7] Surface Engineering Practices: Metallic Coatings, Surface engineering for Tribology problems –
Nitriding, Boronising, Carbide coating, Carburising; Thermal barrier coating for gas – turbine (M C
Al Y type), degradation mechanism; Performance evaluation of High temperature coatings

References:
1) Arthur W. A damson, Physical Chemistry Of Surfaces; John Wiley & Sons
2) K.N. Stafford, Surface Engineering Practices

CH41102: ELECTRO CHEMISTRY OF ELECTRIFIED INTERFACES (3-1-0)

1. (a) Electrified interface: Potential difference across electrified interface, non-polarizable & polariza
interfaces, Concept of surface excess
2. Fundamental treatment of polarizable interface, Lipmann equation, Pzc, Determination of surfa
excess

Structure of electrified interfaces, Helmholtz – Perrin parallel plate condenser model, Gouy – Chapman diffuse charge model of double layer, Stern model, Metal-water interaction, Contact adsorption, Lateral repulsion model of contact adsorption, Potential difference due to water dipole

4. Electro kinetic phenomena, Streaming current, Electrophoresis

5. Derivation of Butler – Volmer equation, High & low field over potential, Nernst thermodynamic treatment. Physical meaning of the symmetric factor (β)

6. Multi step reaction, Butler-Volmer Equation for multi step reaction

7 Transient behavior of interfaces, Experimental methods

8 Transport at charge transfer interface, Flux equality condition, Concept of transition time, Convection causing steady interfacial concentration, Concentration over potential, Diffusion layer, Limiting current density, Rotating disc electrode, Steady state condition for transport control, Transport controlled de-electronation reaction

9. Determining stepwise mechanism of an electrodic reaction

10. Hydrogen evolution reaction: Possible paths for hydrogen evolution reaction, Mechanism in hydrogen evolution reaction, Determination of reaction order with respect to hydrogen ion in solution

11 Introduction to various surface analytical methods.

References:

1) John .O' M. Bockris & Amulya K.N. Reddy, Modern Electrochemistry Vol II; Plenum Press
2) N.D. Tomashov, Corrosion; MIR Publication
3) V.S. Shastri, Corrosion Inhibitors; John Wiley & Sons

CH41103: PHYSICAL METALLURGY AND HIGH TEMPERATURE OXIDATION (3-1-0)

[1] Structure of metals
[2] Plastic deformation of single crystals
[3] Plastic deformation of poly crystalline aggregate
[4] Constitution of alloys
[5] Equilibrium diagrams
[6] Solidification of metals
[7] Iron – iron carbide system
[8] The hardening of steel
[9] Fracture
[10] Materials testing:
Tension Test, Torsion Test, The Hardness Test, Fatigue Test, Creep & Stress Rupture Test
[11] High temperature oxidation of metals:
Thermodynamics and kinetics of oxidation, Zone of film growth, Surface reaction, Theory of High temperature alloys

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[11] High temperature oxidation of metals:
Thermodynamics and kinetics of oxidation, Zone of film growth, Surface reaction, Theory of High temperature alloys

1) Physical Metallurgy Principles; Van Nostrand Reinhold Company
2) Sidney H. Avaner, Introduction to Physical Metallurgy, Tata McGraw-Hill
3) L.L. Shrier Vol. I

CH41104: CORROSION ENGINEERING AND MATERIALS (3-1-0)

1. **Definition Of Corrosion & Stability Of Metals:** Theories of corrosion of metals and alloys [Local cell theory (Role of NMI), Micro galvanic cell (Structural heterogeneity), Differential Oxygen-concentration cell etc., Theory of ultra pure metal, Mixed potential theory], Forms Of Corrosion: Uniform corrosion, Localized corrosion, Pitting corrosion, Erosion corrosion, Fretting corrosion, Cavitational damages, Crevice corrosion, Selective leaching, Graphitisation, Dezincification, Ring worm attack, Galvanic corrosion, Filliform corrosion, Exfoliation, Intergranular attack; Weld decay, Knife line attack, Stress corrosion cracking (SCC), Caustic embrittlement, Hydrogen assessed cracking (HAC), Corrosion fatigue, Fretting corrosion, Fretting fatigue, Liquid metal embrittlement (LME), Weldment corrosion, Marine & Underground corrosion, Stray current attack, In vivo corrosion, Metal matrix composite (MMC) corrosion, Microbial (S.R.B.) corrosion of steel in concrete
   Corrosion under high temperature such as: Oxidation, Carburization, Metal dusting, Nitridation, Halogen corrosion, Sulphidation, Ash/Salt deposit attack, Fused (molten) salt corrosion & High temperature – High pressure conditions.
2. **Factors affecting corrosion:** Environments; Temperature, Turbulence, Concentration-gradient, pH, Once-through & closed re-circulating cooling water system; State of stress, etc.
3. **Metallurgical variables:** Effect of Non-Metallic Inclusions (NMI) & Role of alloying additions and micro structures etc. on corrosion resistance of metals with particular reference to cast iron, steel, stainless steel (Austenitic, Ferritic, Mertenistic), Aluminum, Copper, Nickel & their alloys.
4. **Evans Diagram:** Anodic and Cathodic control, Role of inhibitors, Oxidizers, Temperature, Velocity, etc; Diagram of multi electrode system.
5. **Pourbaix Diagram:** EH-pH Diagram for system like Fe-H_2O, Cu-H_2O, Pb-H_2O, Al-H_2O, Zn-H_2O, Ni-H_2O, etc.
6. **Iso-corrosion Diagram: Characteristics of different metals:** Environment systems; such as steel, Lead, Duriron, Chlorimet, Hestelloy, Inconel, Aluminum & Bronze in Sulphuric acid. Stainless steel, High Si iron, Durimet, Aluminum in Nitric Acid & Mixed Acid. Materials for handling Hydrofluoric Acid, Phosphoric Acid & Hydrochloric Acid.
7. **Corrosion resistant Materials: (a)** Mechanical / Metallurgical properties of selected alloys [Iron & Steel, Low alloy steels, Stainless steels, Cast iron (including high Si variety), Aluminum alloys, Copper alloys, Nickel alloys, Zinc alloys, Titanium alloys, etc.]
   (b) Performance of the alloys with respect to natural environment, such as: atmosphere, underground, seawater, etc.

References:

1) M.G. Fontana & Greene, Corrosion Engineering; Tata McGraw Hill
2) L.L. Shrier Vol. I&II

MH41101: NUMERICAL METHODS AND COMPUTATIONAL TECHNIQUE (3-1-0)

1] Solution Of Equation

1) Bisection Method, 2) Regula-Falsi Method, 3) Newton-Raphson's Method, 4) Secant Method, 5) Iteration Method Or Successive Method.
Rate Of Convergence Of Newton's-Raphson's Method And Secant Method.
Problems Based On Above Methods.

2] Interpolation

1) Newton-Gregory Forward And Backward Interpolation Formula
2) Interpolation For Unequally Spaced Points.
   a) Lagrange Interpolation, b) Divided Difference,
   c) Newton Divided Difference Interpolation.

3] Integration

1) General Integration Formula, 2) Trapezoidal Rule, 3) Simpson's 1/3 Rule, 4) Simpson's 3/8 Rule.
Error Estimation And Problem Based On Above Equation.

4] Solution Of System Of Linear Equation

1) Gauss Elimination Method (Pivoting), 2) Gauss-Siedel Iterative Method (Convergence Condition), 3) Cramer's Rule, 4) Matrix Method, 5) Rank Of Matrix, 6) Consistency Of Matrix, 7) Solution By Method Of Factorization, 8) Eigen Value Problem, 9) Eigen Vector

5] Solution Of Ordinary Differential Equation

1) Picard's Method, 2) Taylor's Series Method, 3) Euler Method, 4) Modified Euler's Method, 5) Predictor And Corrector Method, Milne's Method.

6] **Solution Of Differential Equation**

1) Runga-Kutta Method, 2) Second Order Runga-Kutta Method, 3) Fourth Order Runga-Kutta Method
4) Error Associated.

7] **Curve Fitting**

1) Method Of Least Square.

References:

1) V. Rajaraman, Computer Oriented Numerical Methods; Prentice Hall Of India
2) S.S. Sastry, Introductory Method Of Numerical Analysis; Prentice Hall Of India
3) B.S. Grewal, Numerical Methods In Engineering & Science; Khanna Publishers

CH42101 MECHANISTIC MODELS OF CORROSION /PASSIVATION & FRACTURE (3-1-0)

1) **Passivity:** a) Development of theory; b) Passivation processes, Passivation kinetics, Passive-film characteristics; c) Theories and models: i) Metal-modification theory; ii) Electron-configuration theory; iii) Reaction-rate theory; iv) Oxide film theory; v) Adsorption theory; vi) Ionic space-charge induced passivity, Bipolar fixed charge induced passivity, Ion-transport models, Hopping motion and place-exchange mechanism.
2) **Pitting:** Various models of pitting: i) Adsorption theory, ii) Anion penetration and migration theories. Mechano-chemical model; Point-defect model of pit-initiation; Localized acidification theories. Thermodynamic theory; Depassivation- Repassivation theory.
3) **Mechanism of stress corrosion cracking:** i) Dissolution controlled mechanism; ii) Film-rupture model; iii) Slip dissolution theory; iv) Adsorption theory; v) Strain-enhanced corrosion mechanism; vi) Mass transport-kinetic model; vii) Ligament instability model; viii) Constant charge criteria; ix) Hydrogen controlled mechanism.
4) **Mechanism and theories of hydrogen embrittlement:** i) Pressure theory of Zapffe and recent development, Pressure mechanism by Bockris, by Troiano; iv) Surface-energy concept; v) Cohesive-energy concept (Unified model of hydrogen-embrittlement, Liquidmetal-embrittlement); vi) Decohesion theory (Oriani); vii) Crack-tip plasticity concept; viii) Concept of brittle fracture in ductile material; ix) Dislocation locking (Transport) model; x) Hydride theory; xi) Reaction model.
5) **Fatigue growth mechanism.**
6) **Liquid metal embrittlement.**
7) **Recent models on atmospheric corrosion.**
8) **De-alloying/ Selective leaching:** i) Volume-diffusion model; ii) Enhanced diffusion models; iii) Surface diffusion; iv) Oxide formation; v) Percolation model; vi) Dissolusion-reprecipitation model.
9) **Fracture mechanics applied to stress corrosion cracking, Hydrogen assisted cracking and corrosion fatigue.**

Reference: Passivity: **Passivity of metals by R.P.Frankenthal & J.Kruger, Corrosion monograph series, The Electrochemical Society, Inc., New Jersey.** Pitting: **Pitting corrosion by S.Szklarska-Smialowska, NACE.** Stress corrosion cracking: **i) Proceedings of International conference on Stress corrosion cracking (Ohio State University); ii) Proceedings of Stress corrosion cracking and hydrogen embrittlement of Iron based alloys (University of Firminy, Italy); iii) Stress corrosion cracking by H.Buhl, DFVIR.**

CH42102: CORROSION TESTING / EVALUATION & POLLUTION ASPECTS (3-1-0)

Introduction: (1) Planning and design of tests. **(2)** Types of data: Electrochemical test data, Metallographic analysis, Surface analysis, Statistical treatment of data, Data interpretation and reliability and computerization **Types of test** : Laboratory tests: Electrochemical, Cabinet, Immersion, High temperature-high pressure. Field test: Atmospheric, Sea water, Fresh water, Soil service test: Industrial applications.

Electrochemical methods: Corrosion rates from electrochemical data; Electrochemical methods for uniform corrosion, Polarization methods & complications due to concentration polarization; Polarization resistance methods , Electrochemical impedance (EIS), Electrochemical method for galvanic corrosion, Mixed potential theory, Direct measurement, Electrochemical method for passivity & localized corrosion; Cyclic, Potentiostatic & Galvanostatic methods for localized corrosion, The scratch repassivation method for localized corrosion, Electrochemical noise method, Electrochemical methods for environmentally assisted cracking, Scratch repassivation, Tribo-ellipsometric method, Evaluation of alloy sensitization (ERP), Evaluation of protective coatings & films, Ford anodized aluminum corrosion test (FACT), The electrolytic corrosion test, Paint adhesion on a scribed Surface (PASS), Single frequency test, Electrochemical impedance spectroscopy (EIS).

Cabinet Test: **(A) Types of test:** Controlled humidity test, Corrodekote test, Test for solder fluxes, Water resistance of coating up to RH.=100, Preventive properties of greases and cyclic humidity test. **(B) Corrosive gas tests:** Combined controlled humidity & controlled gases, Test with nitric acid vapour, Test with sulfuric acid/sulfur dioxide vapour, The moist sulfur dioxide test, MFG test (Mixed Flowing Gas Test).**(C) Salt spray tests:** Acetic acid salt fog test, Copper accelerated acetic acid salt spray test (CASS), Acidified synthetic sea water test for exfoliation testing of aluminium alloys, Prohesion test for paints i.e., Periodic spray & exposure to other conditions such as high & low humidity , Temperature , Mechanical forces. **(D) Evaluation** : Practice for preparing , Cleaning , Evaluation & recording data of corrosive tests.

Immersion test: Basic principles: Test conditions, Physical parameters, Test durations type of test; Simple immersion test, Alternate immersion test, Simulation & acceptance testing ; Specimen preparations; Evaluation of results; Standard test procedures.

High temperature & high pressure (aqueous): Basic principle of high temperature & high pressure corrosion test & typical test condition; **Types of tests**: Static tests, Agitated tests, Refreshed & recirculating test, Factors affecting test conditions, Particular test of dissolved oxygen, Hydrogen & other gases, Other types of tests Safety, Standards.

Atmospheric corrosion test: Basic principle: Type of exposures , Atmospheric variables , Classification of atmosphere; **Test programmes and standards:** Practice for conducting atmospheric corrosion test on metals Practice for recording data, Practice for measurement of time for wetness, Practice for monitoring atmosphere Sulfur dioxide, Practice for characterizing test sites, ISO and NACE standard.

Sea water corrosion tests: Basic principle, Specimen configuration, Duration of exposure, Tests for specific types of corrosion, Specimen exposure & retrieval, Corrosion evaluation, Standards.

Fresh water corrosion: Basic principle, Factors affecting water chemistry & others (Temperature, Pressure Metallurgy redox potential, Biological, Velocity & galvanic effect). **Basic testing technique & standards** Practice for laboratory immersion tests, practice for preparing, etc, for test specimen, Practice for electro chemical tests, practice for potentiodynamic polarization resistance measurements, Practice for online monitoring of corrosion in plant equipments etc.

Soil corrosion testing: Basic principle, Design specimen emplacement, Specimen retrieval, Cleaning & evaluation, Physical measurements, Electrochemical measurements, Polarization, Galvanic corrosion, Potential mapping standards.

Industrial in plant testing: Basic principle, Measurement technique, Installation & monitoring devices, Specimen types, **Types of tests:** Electrical resistance probes(SATM G 96), Electrochemical probes (G96), Other methods Safety.

High temperature corrosion tests (dry) : Basic principle of high temperature corrosion ,Chemical thermodynamics & physical principles, Basic modes (Oxidation , Carborization, Nitridation, Sulfidation, etc.) **Pollution aspects:** i) Concept and scope of Environmental Chemistry and Natural Cycles; ii) Metallic corrosion causing Atmospheric, Water, Air pollution; iii) Chemical and Biological analysis of pollutants.

Reference: **(1)** Passivity & passivity of model, R.P Frankenthal & J.Kruger; Corrosion monograph series. The electro chemical society, Inc., Priceton, New Jersey; **(2)** Pitting corrosion , S.Szklarska – Smialowska; **(3)** Proceedings of intermaterial conference of stress corrosion cracking (Ohio state University), 1962. **(4)** Proceedings of intermaterial conference of stress corrosion cracking and Hydrogen embrittlement of iron based alloys (Univ. of Firming, Italy).**(5)** Stress corrosion cracking by H.Buhl, DFVLR. **(6)** Corrosion & corrosion control By L.L.shrier (Vol -11). **(7)** Corrosion test & standards by Robert Baboien .**(8)** A.K.Dey , Environmental Chemistry, New Age, International Pub. (New Delhi).

CH42103: CORROSION PROTECTION AND DESIGN (3-1-0)

Principles of cathodic protection : Electrochemical principle, Protection criteria, current requirement, Potential distribution for finite & infinite length pipe line, Sacrificial anode types, Back fills, Resistivity, Capacity, Efficiency & life of anodes, Design parameters.

Power impressed anode: Types: Ferrous & non ferrous materials, Lead, Carbonaceous materials & rare metal anodes, Practical application of Cathodic protection of buried structure, Cathodic protection instruments.

Anodic protection: Principles, Passivity criteria, Practical aspects.

Conditioning the environment: Corrosion inhibitors, Principles and practice, Classifications, Types, Inhibitors for aqueous solution and steam, Oil industry, Mechanism of inhibitive action: Diffusion barrier, Blocking reaction Alternation of electrical double layer; Inhibitors for neutral and acid solutions, Boiler- feed water treatment Vapor phase inhibitors (VPI).

Pre treatment Prior to applying coating: Pickling in acids , Chemical and electro chemical polishing , Design parameters.

Electroplating: Principles, Pre-treatment, Plating processes, Aqueous electrolytes, Additive agents, Anodes.

strike baths, Factors influencing ; Substrate effects (Epitoxy and Psudomorphism), Electrolyte effects; Properties of electro deposits, Thickness, Throwing power, Current path geometry, Internal stress, Ductility, Hardness, Wear strength, Interdiffusion and porosity.

Metallic coatings: Immersion coating, Chemical reduction, Vaccume evaporation, Gas plating, Cathodic sputtering, Plasma spraying, Properties of sprayed products of aluminium, Cadmium, nickel, Chromium and copper, Electroless coating. Hot Dip Coating: Principles, Tinning, Terne coating, Galvanizing and aluminizing. diffusion coating: Theory, Methods, Gas phase deposition, Chromizing, Aluminizing and properties of coatings.

Chemical conversion coatings: Anodizing, Phospating, Chromate treatment, Temporary protective, Thermoplastic and enamel coatings

Corrosion problems in industry: In chemicals, Fertilizers, Petrochemicals, Steel and automobile industries, etc..

Effective design for corrosion prevention.

BOOKS : (1) Corrosion volume (2) by L.L.Shreir, Newnes- Butterworths (1979), (2) Corrosion inhibitors-Principles and applications, V.S. Sastri, John Wiley and Sons, (3) Cathodic protection By J.H. Morgan, Leonard hills Ltd, London (1959), (4) Cathodic protection by Peabody, Design and corrosion control By VR. Pludek, McMillan Press Ltd., London (1977).

CH42104: PAINT TECHNOLOGY (3-1-0)

1) Principles of Paint Film Formation: Cohesive & Adhesive forces, Film formation by evaporation; Evaporation of solvent plus polymerization.
2) Ingredients of paints:
   (a) Drying oils: The chemistry and properties of drying oils, Types of polymers & physical properties. (b) Pigments: Inorganic Pigments & organic pigments, Types & uses of pigments in industrial finishing. (c) Extenders: Chemical constitution and composition. (d) Solvents: Characteristics of solvent groups, properties; (e) Plasticisers: Types , Mechanism & Uses. (f) Additives: Dryers, Extenders (Oxides, Hydroxides, Carbonates, Silicates, Sulphates), Anti skinning agents, Anti settling Agents, Anti floating and flooding agents, Anti foaming agents; (g) Surface active agents: Types , Physical properties.
3) Surface preparation before painting.
4) Film properties and defects.
5) Application Techniques of paint.
6) Test of paint: A) Test of ingredients (a) Drying oils (Softening point, Iodine value, Gel time, Acetone number). (b) Solvents (Aniline point, Kauri-Butanol value, Flash point).(c) Pigments (Oil adsorption value, Daniel flow point for pigment composition). (d) Dryers (Hydrophilic-Lipophilic Balance number) (e) Liquid Paint(Skinning test, thixotropic test, Solid content, Sagging test, Gel time, Hiding power, Drying time etc.). (B) Test for Coated Sample: Distensibility (Conical mandrel Test), Abrasion resistance (Taber and wheel abrasion test), Impact Testing(Bell lab glancing type test), Hardness (Sword rocker hardness, Pencil hardness), Adhesion (Scrape method, Snatch pull, Scratch method). etc.
7) Modern Paint Technology: (a) Water borne coating : Water soluble, Colloidal dispersion and aqueous dispersion type, Application of water borne coating .(b) Radiation curable coating : Important types (UV curing , Electron beam, Radio frequency, Gamma rays, Microwaves etc..). (c) Powder coatings: Thermo plastic, Thermosetting powder coatings, Application techniques of powder coatings (Electrostatic spraying, Corona charging, Tribo charging, Fluidized bed technique, Electrostatic fluidized bed technique, Flame spray techniques, etc..) (d) High solid liquid coating.(e) Cathodic electro deposition.(f) Anodic electro deposition

Reference (1) Surface coatings, Ed- Swaraj Paul; John Wiley Sons, New York (1996). (2) Organic Coatings By H.F.Payne (Vol-1,2). (3) Outlines of Paint Technology(Vol-1), W.M . Morgan; Edward Arnold Publication (1990). (4) Water Borne Coating Emulsion and Water soluble Paints, Charles R. Martens,Van.Nastand Rainhold company Network (1964). (5) Paint Calculations by OCCAA Publications.(6) Powder Coatings Chemistry and Technology, Ed- T.A.Misev, John Wiley and sons, New York.(1991).

GE42201 PERSONNEL MANAGEMENT AND INDUSTRIAL RELATIONS (3-1-0)

Objectives: a) To create an understanding of the various aspects of the management of human resources, their interaction in the execution of managerial functions. b) To facilitate learning of various concepts and skills required for utilization and development of human resources for organizational functions. c) To impart basic knowledge of the Indian Industrial Relations System. d) To build awareness of certain important and critical issues in the Indian Relation System. e) To provide an exposure to the required skills for managing Industrial Relations.

Topics: 1) Personnel and HRM: a) Philosophy- Peace, Happiness and Prosperity only through HRM. b) Strategic Purpose and Business Objectives. c) Its Position in the Organization. d) Line and Staff Linkages and Responsibilities e) Factors influencing HRM.2) Manpower Planning for Organizational Development: a) Challenges. b) MPP and Its Organizational Linkage- Macro and Micro Levels. c) Process of Planning. d) Procedures and Steps for an Effective Planning through Acquisition and Analysis of Data and Information, Designing and Implementing Plans and Actions, Controlling and Evaluating. 3) Employment Function: a) Challenges. b) Recruitment- internal vs. external. c) Selection. d) Placement. e) Induction (Employees Awareness) Programme. 4) Evaluation and Carrier and Succession Planning: a) Performance Appraisal System (PA).b) Performance Appraisal Process. c)Carrier Management. 5) Training and Development (T and D): a) Need for T and D. b) Individual vs. Organizational needs. c) Training Objectives and Strategies. d) Training Methods and Techniques. e)Design and Organization of Training (Evaluation of Training). 6) Compensation System (Pay and Benefits): a) Some Thump Rules about Compensation Systems. b) Implementation and Administration of Companies. 7) Industrial Relations System: a) Its Structure, the Hectors their Interrelationships. 8) State, Trade Unions and Employer's organizations. 9) Grievance Management: a) Nature and Causes of Grievance. b) Practice and Procedure of Handling Grievance. 10) Discipline: a) Approach to Discipline. b) Disciplinary Proceedings (Domestic Enquiry). 11) Industrial Conflict an its Resolution: a) Nature of Conflict and its Manifestation – Dispute Settlement Methods, Collective bargaining, Conciliation, Adjudication, Arbitration. 12) Industrial Democracy: a) Workers Participation: Form, Level, Government's Policy.

DEPARTMENT OF ELECTRICAL ENGINEERING.

M.Tech., (POWER SYSTEM)

EE41101 Computer Methods in Power System (3-1-0) Credits - 4

Incidence and Network Matrices

Graph, Tree, Co-Tree, Branch, Link, Element, Basic Cutset, Tie Cutset, Basic loop, Open loop, Element node incidence matrix, Bus Incidence matrix, Branch path Incidence matrix, Basic cutset incidence matrix. Augmented cut-set incidence matrix, Basic loop incidence matrix, Augmented loop incidence matrix, Primitive network. Performance equance in Impedance and Admittance form. Formation of Bus Admittance matrix by singular Transformation, Numerical Problems.

Algorithm for formation of Bus Impedance Matrix

Performance equation of Partial Network, Addition of a branch, Addition of a Link, Numerical problems

Three Phase Network

Three phase network elements, Three phase balanced network elements, Transformation matrices. Symmetrical components, Clarke's components. Balanced excitation. Unbalanced excitation. Three phase unbalanced network elements.

Short Circuit Studies

Short circuits calculations using Z_{Bus}, System representation, Fault currents and voltages, Short circuits calculations for balanced three phase network using Z_{Bus}, Transformation to Symmetrical component. Three phase to ground fault, Single line to ground fault.

Load Flow Studies

Network Model Formulation, Buses, Solution Techniques, Power System Equations, Network Performance equations, Bus loading Equations, Line Flow equations, Gauss Interactive method, Gauss Scidel Iterative method, Newton – Raphson method, Acceleration factor, Decoupled Newton Method, Decoupled load flow method. Flow charts. Numerical problems.

Transient Stability Studies

Swing Equation, Machine equations, Power System equations, Representation of loads, Network performance equations, Solutions, Solution Techniques, Preliminary calculations, Modified Euler method, Runge – Kutta method, Numerical problems.

Books: (i) Computer methods in Power System Analysis Pb McGraw Hill, Auth: GW Stagg & A.H.El-Abiads.

(ii) Advanced Power System Analysis and Dynamics Pub Wiley Eastern Ltd., Auth: L.P.Singh.

EE41102 Control Theory (3-1-0) Credits - 4

Continuous time system :

Introduction to modern control, State variable analysis of dynamic systems. Different canonical form representation and realization, Solutions of State equations, Controllability and observability, Linear transformation, control system design via pole – placement technique. Stability: Stability analysis and Liapunov's method. Introduction to optimal control – quadratic performance Index and regulator problems. Introduction to non – linear system and robust control.

Discrete – time System :

Z – transform and their properties, Solution of difference equation, Z.O.H., Pulse transfer function, Sampling theorem, Bilinear transformation; State – Space representation and Solution of discrete – time system. Stability analysis of discrete time system. Jury's criterian etc.

Ref. :
1. Modern Control Engg. by K. Ogata
2. Digital Control System by K. Ogata
3. Control System Theory by S.D.Gupta
4. Digital Control System by B.C.Kuo
5. Modern Control System Theory by M.Gopal
6. Digital Control Engg. by M.Gopal

EE41103 Generalized Theory of Electrical Machines (3-1-0) Credits - 4

1. General introduction on the subject area.

2. Primitive Machine Model – concept of PSEUDO – STATIONARY WINDING.

3. (a). Derivations for expressions for transformer e.m.f. and rotational e.m.f. in primitive machine mode
(b). Understanding/explanation on Sign conventions of rotational e.m.f.'s of D & Q coils.

4. Voltage – current relation in a typical 4 – coil primitive machine model – Development of Impedance Matrix.

5. Generalised Torque Equation in a primitive machine model – Drivation for the equation, $T_e = i_d q - {}_d i_q$.

6. Derivations for expressions for inductances in the phase – model of salient – pole 3 – phase Synchronous, Machine, as a function of space angle (ö).
   - Expression for self inductances of armature phase windings.
   - Expressions for mutual inductances between phase windings of armature.
   - Expression for mutual inductances between each phase of armature winding and field winding, direct axis damper winding and quadrature axis damper winding.

   Per Unit Quantities : Relation between per unit and actual quantities, Relations involving flux linkage, currents etc.

8. Sub. : Transient and Transient Equivalent circuits of three phase Salient pole synchronous machine, with damper winding on two axes :-
   - Small perturbution Model involving flux – linkage and current and constant Flux linkage theorem.
   - Development of subtransient and Transient equivalent circuits along direct axis and quatature axis, seperetely.
   - Derivation for expression for x_d'', x_d', x_d, x_q'', x_q.
   - Derivation for different time constant such as :
     T_{do}', T_{do}'', T_d', T_d'', T_{qo}'', T_q''

9. PARK'S Transformation applied to three phase Synchronous Machine :
   (a). Necessity of the Park's Transformation
   (b). Derivation for suitable Transformation Matrix and its inverse.
   (c). To develop the Impedance Matrix of a three phase salient – pole Synchro Machine after applying PARKS' Transformation.

10. Operational Reactances and Transfer Function of Salient – pole Synchronous Machine :
   (a). Direct – axis operational Reactance (x_d (s) – Derivation/Analysis.
   (b). After Function (G(s)) – Derivation/Analysis.

(c). Quadrative Axis operation Reactance (Xq(s)) – Derivation/Analysis.
(d). Derivation for expression for the ter $1/X_d$ (s) and K/X_q convenient forms.

11. (a). Derivation for expression for armature winding current of three phase salient pole synchronous generator as a function of time when :
(i). Suddent short – circuit is imposed on the armature terminal of an unloaded generator.
(ii). Sudden of short – circuits is imposed on the armature terminals of a loaded generator.
(b). Derivation for the expression field winding current as a function of time due to sudden short circuits imposed on the armature terminals of unloaded generator.

12. Derivation for expression for armature winding current of a conventional D.C. separately excited generator, as a function of time, when their is a sudden short circuit on the armature terminals of the unloaded generator.

13. (a). Dynamics of D.C. Machine and three phase Induction Machine and three phase Synchronous Machine, Necessary Analysis.
(b). Self – Oscillation and Forced – Oscillation Problems in three phase Synchronous Meter, involving torque angle – Necessary Analysis.

14. Development of State Variable Model of a three phase Synchronous Machine.

EE41104 Introduction to Microprocessor and its Applications (3-1-0) Credits - 4

Introduction to microprocessors and microcontrollers, architecture of 8 – bit and 16 – bit microprocessors and microcontrollers and co – processor Instruction sets and assembly language programming, Interfacing of memory and I/O devices. Review of peripheral devices. Interrupts and Data transfer schemes. Hardware and Software Developments tools and trouble shooting techniques, Typical application in Power system, Drives and Instrumentation.

EE42105 Thyristor Circuits and Applications (3-1-0) Credits - 4

Power device (Diodes, SCR, GTO, Power Transistors, Power MOSFET and IGBT), their structure, rating and characteristics; driver circuits, protection scheme and heat sink, snubber circuit design.
AC – DC converters : Analysis of single/three phase converters, series/parallel converter and dual converter, performance parameters, harmonics, and effect of source inductance.
AC regulators, Cycloconverters, reactive power compensator, harmonic analysis.
DC – DC converters : Choppers control strategies, classification of choppers, Buck, Boost, and Buck – boost converters, Resonant Converters.
Inverters : square wave and PWM type, harmonics, and speed control of induction motors.
Non – drive applications of power converters : Induction heating, UPS and electronic ballast, HVDC transmission system.

EE42106 Power System Stability (3-1-0) Credits - 4

Stability concepts, Steady state stability limits of Synchronous machines and transmission systems. Dynamic and transient stability. Modelling of Synchronous machine, excitation system and speed governing system for stability Studies, Effect of power system Stabilisers.

Transient and dynamic stability study of integrated power system using Range Kulta. Modified Enter and Trapezoidal rule methods. Model reduction and power system equivalents. Application of State variable and Lyapunov's method for Stability Study.

EE42107 Power System Protection (3-1-0) Credits - 4

Philosophy of power system protection and its basic requirements.
Phase and Amplitude Comparators – General Equations, Duality, Types of phase and amplitude comparators.

Realisation of distance relay characteristics using amplitude phase comparators.
Conic section characteristics – Realisation using three input comparators, hybrid comparators.
Static differential and over current relays.
Protection schemes for system apparatus and line protection.
Microprocessor based relays.
Computer application protective relaying.

EE42108 Power System Transient (3-1-0) Credits - 4

1. Simple Switching Transients.
2. Damping – Concerned Analysis in different types of network using Laplace Transform.
3. Analysis of Magenetising current Chopping in a transformer with damping :-
   (a). Physical explanation of the phenormenon – Concept of Abnormal Transient.
   (b). Derivation for the expression for the concerned variable in time domain using Lap Transform -
4. Magnetising Inrush current in a transformer :-
   (a). Physical explanation of the phenomenon.
   (b). Time response of flux.
5. Travelling Waves in Transmission lines :-
   (a). Development of partial differential equation,
   (b). Reflection coefficient, Transmission coefficient,
   (c). Analysis for derivation for expression of transmitted current as a function of time u conditions:-
      (i). Line terminated by resistance
      (ii). Line terminated by impedance resistance in parallel with capacitance.
      (iii). Line terminated by inductance.
   (d). Numerical problems on Beweley's Lattice Diagram.
6. Electromagnetic field Transients :
   (a). Flux penetrati on in a solid conductor – Analysis.
   (b). Depth of penetration.
7. Resistance Switching :
   (a). Necessity of resistance switching.
   (b). Analysis for time response of voltage. across the circuit breaker – Consideration of diffe cases like under damped, Critically Damped and overdamped Oscillations
8. Derivation for expression current transient due to a fully rectified voltage waveform with R – L loa
9. Current Limiting Static circuit Breaker :-
   Circuit diagram – Physical explanation of the circuit operation – Advantages.
10. Derivation for expression for current in a R – L series circuit excited by output voltage from a th phase six – pulse rectifier.
11. Analysis for arcing current due to opening of a highly capacitive circuit – Expression for volta across capacitor as a function of time.
12. Three phase capacitance Switching – Analysis.

GE42101 Personnel Management and Industrial Relations (3-0-0) Credits - 3

Objectives: a) To create an understanding of the various aspects of the management of human resourc their interaction in the execution of managerial functions. b) To facilitate learning of various concepts and sk required for utilization and development of human resources for organizational functions. c) To impart ba knowledge of the Indian Industrial Relations System. d) To build awareness of certain important and critic issues in the Indian Relation System. e) To provide an exposure to the required skills for managing Indust Relations.

Topics: 1) Personnel and HRM: a) Philosophy- Peace, Happiness and Prosperity only through HRM. Strategic Purpose and Business Objectives. c) Its Position in the Organization. d) Line and Staff Linkages a Responsibilities e) Factors influencing HRM. 2) Manpower Planning for Organizational Development Challenges. b) MPP and Its Organizational Linkage- Macro and Micro Levels. c) Process of Planning Procedures and Steps for an Effective Planning through Acquisition and Analysis of Data and Informatio Designing and Implementing Plans and Actions, Controlling and Evaluating. 3) Employment Function Challenges. b) Recruitment- internal vs. external. c) Selection. d) Placement. e) Induction (Employe Awareness) Programme. 4) Evaluation and Carrier and Succession Planning: a) Performance Appraisal Syste (PA).b) Performance Appraisal Process. c) Carrier Management. 5) Training and Development (T and D) Need for T and D. b) Individual vs. Organizational needs. c) Training Objectives and Strategies. d) Traini Methods and Techniques. e) Design and Organization of Training (Evaluation of Training). 6) Compensatio System (Pay and Benefits): a) Some Thump Rules about Compensation Systems. b) Implementation a Administration of Compensation. 7) Industrial Relations System: a) Its Structure, the Aectors the Interrelationships. 8) State, Trade Unions and Employer's organizations. 9) Grievance Management: a) Natu and Causes of Grievance. b) Practice and Procedure of Handling Grievance. 10) Discipline: a) Approach Discipline. b) Disciplinary Proceedings (Domestic Enquiry). 11) Industrial Conflict an its Resolution: a) Natu of Conflict and its Manifestation – Dispute Settlement Methods, Collective bargaining, Conciliation, Adjudicatio Arbitration. 12) Industrial Democracy: a) Workers Participation: Form, Level, Government's Policy.

Department of Mechanical Engineering

M.Tech., Computer Integrated Design and Manufacturing (CIDM)

ME41101 Analysis and Dynamics of Mechanisms (3-1-0)

Geometry of Motion :Analysis is a synthesis, terminology & definition, planer, spherical and spatial mechanism, mobility, kinematics inversion, Grashof's law, mechanical advantage, straight line mechanism, quick return mechanism.

Position and Displacement:Position of a point, position difference between two points, apparent position of a point, absolute position of point, loop closure equation, graphical position analysis of planer mechanism, complex-algebra, solution of planer vector equation, algebraic position analysis of planer linkages.

Velocity: Definition of velocity, rotation of rigid body, graphical velocity analysis, the apparent velocity of a point in moving coordinate system, velocity analysis using complex algebra velocity analysis using vector algebra.

Acceleration :Definition of acceleration, angular acceleration of rigid body, graphical acceleration analysis, analytical methods of acceleration analysis.

Numerical Methods in Kinematic Analysis : Introduction, methods in kinematics analysis, programming the chase equation, computer program for planer mechanism.

Dynamic Forces :Rigid and elastic force analysis, centroids and centre of mass, moment of inertia, inertia force and D'Alembert's principle, rotation about a fixed centre, measurement of moment of inertial, analysis of four bar mechanism, computer analysis.

ME41102 Advance Mechanics of Solids (3-1-0)

Mathematical preliminaries, analysis of stress and equilibrium, analysis of strain and compatibility, stress-strain relations, elastic and plastic stress function, plain stress, plain strain, torsion of non-circular bars, theory of simple beams, bending of plates, strain energy methods, introduction to Photometry, introduction to electrical resistance and other experimental techniques.

ME41103 Numerical Methods (3-1-0)

Computer Arithmetic :Floating-points and constants. Errors and approximation.

Numerical Solution of Non-linear Equations in the variables: Newton-Raphson method, Bisection methods, Method of false position.

Linear Algebra : Review of Matrix algebra and Determinants. Inverse of a matrix, Rank of a matrix, quadratic form, Eigen values and Eigen vectors. Solutions of systems of linear equations. Gauss elimination method and Gauss-seidel iterative method. Determination of Eigen values of matrix.

Interpolation :Interpolation formulas of Newton and Lagrange, Spline Interpolation. Interpolation. Interpolation for functions of two or more variables.

Numerical Integration and Differentiation :Numerical integration, Newton-codes formulas (Trapezoidal), Simpsion's rule, Weddle rule, Error estimate, Gaussian integration formulae, Numerical Differentiation.

Numerical Solution of Ordinary Differential Equations :Euler's Picard's and Taylors series methods. Runge-Kutta methods, Predictor-correction methods.

Numerical Solution of Partial Differential Equations : Numerical solutions of Elliptic, Parabolic and Hyperbolic partial differential equations.

ME41104 Programming in High Level Language (3-1-0)

Structure Programming: Introduction, Data type, Operators and Expressions in C++ Control flow, Function, Arrays, Strings and Structures

Object Oriented Programming: Introduction, Classes and Objects, Constructor and Destructor, Inheritance, Operator Overloading, Pointer, Polymorphism, Virtual Function and Friend Function, File and Stream

Data Structure in C++: Operations on array, Stack, Queue, Link list and Tree

ME41105 System Optimization and Management (3-1-0)

Linear Programming : assignment problem, transportation problem, Modi method, Vogel's approximation method, Simplex technique, Duality.

Non-linear Programming :Kuhn-Tucker condition,

Simulation and Monti-Carlo Technique, generation of random numbers.

Reliability centred Total Productive Maintenance(TPM): Productivity, major losses, measurement of overall performance, pillars of TPM, autonomous maintenance, continuous improvements(KAIZEN), maintenance prevention, safety and hygiene, preventive maintenance, predictive maintenance and time based maintenance. Why-Why analysis, failure-mode and evaluation of criticality analysis.
Value Engineering: Type of value, cost vs quality, FAST diagram, phases of VE, application & benefits of VE

ME42106 Artificial Intelligence and Robotics (3-1-0)

Artificial Intelligence: Introduction to A.I., areas of A.I. research, history of A.I., search techniques.
Knowledge representation, first order predicate calculus, Horn clauses, semantic nets, portioned nets, production rules, knowledge base, inference system, forward and backward deductions, prepositional calculus.
Understanding natural languages, parsing techniques, context free and transformational grammar, transition nets, augmented transition nets.
Pattern recognition, structured descriptions, symbolic descriptions, perception, object identification.
Brief description of the A.I. language—LISP
Robotics: Robotics Technology: Robot Anatomy, Control Systems, Accuracy and repeatability, other specifications. End effectors, Sensors in Robotics.
Robot Programming: Types of programming lead through programming, Robots Languages, simulation and offline. Programming work cell control.
Robot Applications: Characteristics of Robot applications, Robot Cell Design, Types of Robot applications material Handling, applications, processing Operations, Assembly and Inspection.

ME42107 Computer Aided Design (3-1-0)

Introduction: CAD/CAM definition, product cycle, Automation Computer Technology : CPU, types of memory input/output
Sequence control and Programmable controllers: Logic control and sequencing, logic control elements sequencing of elements, ladder logic diagrams, programmable logic controllers
Data and File Structures: Primitive and composite data types, applications and operations of strings, arrays stacks, queues, linked list, trees and graphs, searching and sorting techniques, sequential files, direct access files, indexed sequential files, B-trees.
Data Base Design: Design theory for relational database, query languages, data base protection, concurrent operations on database, distributed database.
Fundamentals of CAD : Introduction, design process, application of computers for design, benefits of computer aided design, some examples.
Hardware in Computer Aided Design : Introduction, design work station, graphics terminal, operator input devices, plotters and other output devices, CPU, secondary storage
Implementing a CAD system: Introduction, Turnkey CAD system, selection criteria, evaluation of alternative systems

ME42108 Computer Aided Manufacturing (3-1-0)

Introduction: Numerical control, coordinate system and machine motions, types of NC systems, Machine Tool and other applications.
NC Part Programming: punched tape and tape format, methods of NC programming, manual part programming computer assisted part programming, APT languages, NC part programming using CAD/CAM
Adaptive Control: Definition, control system, current trends in NC
Automated Inspection and Testing: Statistical quality control, automated inspection principles and methods sensor technology, coordinate measuring machine, machine vision, other optical inspection methods.
Computerised Manufacturing Planning System: Computer aided process planning, computer integrated production planning system, MRP and cpacity planning.

Shop Floor Control and Automated Identification Techniques: Shop floor control, factory datas collection systems automated identification systems, bar code technology, automated data collection system
Networking: Hierachal of computers in manufacturing, local area network, manufacturing automation protocol
Flexible Manufacturing and Group Technology: Part families, part classification and coding, product flow analysis and machine cell design, FMS work station, material handling and storage system, computer control system planning of the FMS
CAD/CAM Automation: Product cycle, CAM hardware, computer system interface A/D and D/A converters.

ME42109 Computer Graphics (3-1-0)

Introduction: interactive graphics, graphics hardware, geometrical transformations, viewing in three dimensions, drawing algorithms, introduction to curve representation, introduction to surface representation, hidden edges surface elimination algorithms, shading models, clipping algorithms.

ME42110 Finite Element Methods (3-1-0)

Introduction to finite element methods, general description, concept of finite elements, discretization and interpolation function, steps of finite element analysis procedure.
Calulus of variation: functions and functional, Euler Langrange equation, boundary conditions, determination of functional for plane and axisymmetric elastic problems, heat conduction problems, plates and shells problems.
Finite elements: one, two and three dimensional elements, generalized local, global and natural co-ordinate systems, isoparametric, interpolation function, field variable model for displacement and temperature.
Direct, variational and Galerkin methods, equations of single elements and assembly of elements and solutions
Application to plane and axisymmetric elastic problems, heat conduction, plates and shells problems.

Department of Met. Engg. And Mat Science

M. Tech Course in Extractive Metallurgy
(Iron & Steel)

MT 41101 Met. Thermodynamics (3-1-0) **Credit: 4**

Thermodynamics of solutions – Interaction and activities in multi component phase equilibria and phase relationship in multi component systems. Slag theory: Electro-chemical reaction in Metallurgy. Reaction rate theory and mechanism of homogeneous and heterogeneous metallurgical processes. Models of mass-transfer co-efficients and rate controlling steps. Examples and problems.

MT 41102 Iron making (3-1-0) **Credit :4**

Problems of Iron making in India : Raw materials, characteristics Burden-preparation and raw materials beneficiation, Sintering and pallestising, Quality Control of sinters, Their effects on furnace operation. Thermodynamics and kinetics of reduction of Iron-ore.
Critical analysis of conditions prevalent in Blast furnace and their interactions on the reduction of Iron oxides. Slag formation and Metaloid reduction. Techniques of intensification of B.Fce. process for higher productivity and low coke rates i.e. fuel injection, High Blast Temp., High top pressure. Pre-reduction etc. Controlling Iron-quality and slag rate.
Alternate methods of Iron production Their technology and present status, economics. Its special relevance under Indian conditions.

MT 41103 Transport Phenomena Department (3-1-0) **Credit : 4**

Unified approach to transport processes, differential equation of transport processes, Definition of transfer co-efficient. Momentum transfer, application. Heat transfer by conduction connection and radiation. Solution of Fourier equation for different boundry conditions. Application to various metallurigical processes.

Concept of mass transfer, molecular mass transfer, convective mass transfer. Heat and mass transfer with phase change. Aplications to various metallurgical processes.

MT 41104 N.M.C.T (2-1-0) **Credit : 3**

MT 42101 Pneumatic Steel making (3-1-0) **Credit : 4**

Development of penumatice proceses and their contribution in workd steel production. Interaction between gas jet and molten metal. Sequence of removal of impurities and their control. Effects of mixed gas blowing on operational parameters and product quality. Types of the oxygen processes of steel making. Design and special feature of L.D. converter plants and other variations like OBM, QBOP, OLP etc., Special features of bath dynamics and its effect on Metallurgical reaction of C, Si, Mn, P and S in these Processes. Control of Metal composition and quality of steel.
Role of slag in oxygen steel-making.
Examples of making various grades of steel L.D. converter Thermal and material balance of L.D. and allied processes. Instrumentation and Automation of oxygen converter plants, Continuous steel making processes.

MT 42102 Electric Steel Making (3-1-0) **Credit : 4**

Role and importance of Electric steel making India-Modern developments in Electric furnace designs. Plant & accessories. Power characteristics for different furnaces. Refractories & raw materials.

Operation and control for carbon, alloy and special steels: Alloy recoveries. Use of protective atmospheres and vacuum. Use of sponge-iron as raw material.

Deoxidation and degasification of alloy & special steels.
Mini-steel plant technology in India.

MT 42103 Secondary Steel Making (3-1-0) **Credit : 4**

Importance and economy of secondary refining of steels. Special features and their applications. Critical studies of vacuum degassing, Vacuum – Acr and and Electro-slag, Plasma Arc, remelting, AOD, VOD, RH and DHH processes of fefining of steels. Ladle- Metallurgy.

MT 42 104 Quality Control & Finishing of Steel Department (3-1-0) Credit : 4

Scope of quality control in iron & steel plants. Sampling, test and analysis and their critical appraisal. Quality control methods, instruments and their applications. Performance control and acceptance control. Indian standard specifications for tests and important steels.
Ingot quality, cleanliness and degasification. Continuous castings of steel and its quality and economy.

MT 42 105 Energy & Materials Managements (3-1-0) Credit : 4

Iron and steel as energy and materials intensive industry. Economy of energy and material management. Material preparations for making Iron in B.Fce. Viz. washing, sizing, sintering, pelletising, fluxed and super-fluxed sinter. Coal washing and coke quality control. Energy sources and optimal use in steel making processes as well as in transport and handling of materials in modern steel plants. Material recovery and waste utilization.

MT 41105 Solidification of metals and alloys (3-1-0) **Credit: 4**

Thermodynamic conditions for solidification- Solidification as atomic process. Nucleation and heat flow. Stability of nuclei and conditions for growth- Growth rate and heat flow relationships- controlling factors. Structure of cast metals and alloys. Distribution of solutes during doldivation, coving and segregations solidification in continuous casting. Centrifugal casting. Chilled castings- effect of pressure, and other variables. Unidirectional solidification of castings and effect on properties.

MT 42106 Metal Melting Technology (3-1-0) **Credit: 4**

Melting furnaces for ferrous and non ferrous foundries. Electric and fuel fired furnaces, recent developments in energy considerations. Melting practice for carbon steel and alloy steel, stainless steel, Manganese steel, high alloy aircraft, quality steel and super alloys.
Secondary refining of melting of cast iron- gray, malleable C.G. , S.G., Ni-hard, Ni-resist, high silicon iron. Inoculation methods and materials, melting practice of non ferrous alloys of al, Cu, Mg, Zn and Ni, refining, deoxidation, degassing and grain refinement treatments. Heat treatments of castings, shop floor melt quality tests.

MT 42107 Structure and Properties of Cast Metals (3-1-0) **Credit: 4**

Structure- property relationship in cast alloys. Detailed study of mechanical and other properties. Foundry properties, mechanabilities, weldability and response to heat treatment of various types of C.I., steel, Cu, Al, Ni, Zn, Mg based alloys. Outstanding characteristics of casting alloys,
Techniques of strengthening and improving the properties of cast metals and alloys.

MT 42108 Foundry Technology-I (3-1-0) **Credit: 4**

Recent developments in design, materials and methods of manufacture of patterns. Modification in casting design with reference to foundry and metallurgical principles. Principles design and methods involved in gating and risering of ferrous and non-ferrous castings.
Recent developments in materials and methods of mould and core making such as high pressure moulding, V-process, magnetic moulding, sodium silicate based processes, shell process, hot box, cold box, full moulding etc., moulding and sand conditioning equipments, send reclamation, principles, technology and scope of sand casting processes. Non-metallic mould etc.

MT 42109 Foundry Technology- II (3-1-0) **Credit: 4**

Precision casting processes- Principles, Technology and scope of Die casting, continuous casting, investment casting, Slush casting, casting defects, metal-mould reactions, metal penetration and burnon etc. general principles and objectives of foundry mechanization and lay cut.

MT 42110 quality control of castings (3-1-0) **Credit: 4**

Aims and objectives of quality control. Analytical instruments used in foundries. NDT-X-rays, ultrasonic, magnetic flow detection and recent developments. Control charts, computer application in foundry process, control using mathematical model. Linear programming CPM & PBRT, multiple linear regression analysis. Future application of computer for complete automation in foundries. Statistical quality control in foundries. Surface quality and dimensional tolerances.

Department of Computer Applications

MASTER OF COMPUTER APPLICATIONS

First Semester

CA31101 Foundation of Information Technology Concepts (3-1-0)

Information concepts and processing : Evolution of information processing, data information language and communication.
Elements of computer processing system : Hardware – CPU, storage devices and media, VDU, input-output devices, data communication equipment Software- system software, application software.
Programming languages : Classification, machine language, assembly language, higher level languages, fourth generation languages.
Operating systems : Concept as resource manager and coordinator of processor, devices and memory. Concept of priorities, protection and parallelism. Command interpreter, Typical commands of DOS/UNIX/Network, GUI – Windows.
Computers and communication : Single user, multi-user, work station, client server systems, Computer networks, network protocols, LAN, WAN, Internet facilities through WWW, Mosaic, Gopher, html, elements of Java.
Information integrity : Definition, ensuring integrity, computer security, perverse software, concepts and components of security, preventive measures and treatment.
Range of application : Scientific, business, educational, industrial, national level weather forecasting, remote sensing, planning, multilingual applications.

CA31102 Computer Organisation and Architecture (3-1-0)

Representation of information : Number systems, Integer and floating point representation, Character codes (ASCII, EBCDIC), Error detection & correction codes.
Basic building blocks : Boolean Algebra and logic gates, Combination logic design, Flip-Flops, Registers, Counters, ALU.
Principles of computer design : Software, hardware interaction layers in computer architecture. Central processing unit. Machine language instructions, Addressing modes, Instruction types, Instruction set selection, Instruction cycle and execution cycle.
Control unit : Data path and control path design, Microprogramming Vs hardwired control, RISC Vs CISC, Pipelining in CPU design, Superscalar processors.
Memory system : Storage technologies, Memory array organization, Memory hierarchy, interleaving, cache and virtual memories and architectural aids to implement these.
Input-output devices and characteristics : Input-output processing, bus interface, data transfer techniques, I/O interrupts, channels.
Performance evaluation : SPEC makes, Transaction Processing benchmarks.

CA31103 Mathematics for Computer Science (3-0-0)

Set Theory, Relations and Functions : Review of basic set theory. Mathematical induction. Principle of inclusion and exclusion. Types of relations and functions. Equivalence relation and partition. Composition. Pigeonhole principle. Indexed classes of sets. Countable and uncountable sets, cardinality
Logic and Propositional Calculus : Propositions and truth tables. Algebra of propositions. Propositional functions.
Languages, Grammars, Machines : Languages, regular expressions, regular languages, Phrase structure grammars, types of grammars. Finite state automata, pumping lemma, Finite state machines.
Algebraic Systems. : Semigroups, Monoids and Groups. Subgroups, normal subgroups and homorphsms Rings, integral domains and Fields. Vector spaces, inner products, norms.
Ordered Sets and Lattices : Partially ordered sets, Chains, Well ordered sets. Duality. Lattices, types of lattices.
Boolean Algebra : Definition and basic theorems. Boolean Algebras as lattices. Boolean functions and Boolean expressions. Applications in Propositional Calculus and Switching Circuits.

CA31104 Probability & Statistical Computing (3-1-0)

Probability Classical frequency and axiomatic approach to probability. Marginal and conditional probability. Baye's theorem and independence.

Expectation & Random Variable : Definition of random variable, discrete and continuous. Probability mass function and probability density function. Mathematical expectation. Moment, moment generating function characteristics function.
Probability Distributions: Discrete-uniform, binomial, Poisson, hypergeometric distributions. Continuous - Exponential, normal (univariate & multi variate), beta & gamma distributions.
Law of Large Numbers: Weak law of large numbers, Chebycheff's law of large numbers. Central limit theorem.
Sampling Distributions: Concept of sampling distribution. χ^2 (Chi-square) distribution. Distribution & sampling mean and variance. Student's 't' Fisher's 't' distributions, F distribution and their interactions.

Statistics
Review of measure of central tendencies, measure of dispersion, and correlation & regression. Multivariate correlation and regression coefficients.
Estimation: Criteria of good estimation. Cramer-Rao inequality, Rao-Black well theorem. Methods of estimation. Interval estimation.
Testing of Hypothese: Definition of various hypothese. Type I and type II error. Power function and power of the test. Neymann Pearson lemma, most powerful test. UMP test, likelihood-ratio test.
Standard Error & Test of Significance: Standard error & sample proportion and means. Large sample test of significance of proportion mean. Test of significance based on χ^2 (Chi-square), t and F distributions. Fisher's Z-transformation. Test of significance & sample correlation and regression.
Analysis of Variance: One way classification & two way classification.
Multivariate Statistical Analysis: Discriminant analysis, component analysis, factor analysis, cluster analysis, logic analysis

CA31105 Programming and Data Structures (3-1-0)

Introduction : Algorithms, Flow charts, Problem solving methods, Need for computer languages, Structure of a C program, Data type, Constants, Variables, Identifiers, Key words, Declarations, Expressions, Statements and Symbolic constants.
Input and Output: getchar, putchar, scanf, printf, gets, puts, functions, Pre-processor commands, Preparing and running a complete C program.
Operators and expressions : Arithmetic, unary, logical, bit-wise, assignment and conditional operators, Library functions.
Control statements: While, do-while, for statements, nested loops, if-else, switch, break, continue and goto statements, comma operator.
Functions : Defining and accessing function, passing arguments, function prototypes, recursion, use of library functions, storage classes.
Arrays: Defining and processing an array, Passing array to a function, Multi dimensional arrays, String handling, Operations on strings.
Pointers: Declarations, Passing pointer to a function, Operations on pointers, Pointers and arrays, Arrays of pointers.
Structures and unions: Defining and processing a structure, Passing structure to a function, Pointers and structures, Unions.
File handling : Open, Close, Create, File operations, Unformatted data files, Command line arguments.
Fundamental notations : Primitive and composite data types, Times and space complexity of algorithms.
Algorithm design and Data structure : Introduction to design and analysis of algorithm, Top-down and bottom-up approaches to algorithm design, Structured approach to programming, Stacks, Queues, Linked lists, Trees and their applications.
File structures : Concepts of fields, Records and files, Sequential file organisation, Variable length records and text files, Indexing structures like B-trees, ISAM, Hashing techniques for direct files, Inverted lists, Multilists.
Sorting and Searching: Internal and external sorts, Searching techniques, Merging algorithms.

CA31106 Optimization Techniques (3-1-0)

Linear programming: Mathematical model, assumptions of linear programming, principles of simplex method, duality and post-optimality analysis, dual simplex method, parametric programming, computer solution of L. P.
Special types of linear programming problems : Transportation, transhipment and assignment problems, multidivisional problems, goal programming, linear programming in practice.
Integer programming: Introduction, branch and bound technique, binary linear programming, travelling salesman problem, applications of integer programming.
Dynamic Programming : Bellmains principle of optimality, various examples of D.P. models and computations (deterministic cases only).

Second Semester

CA32107 Interactive Computer Graphics & Multimedia (3-1-0)

Computer Graphics Applications; Interactive graphics, Graphics devices; Memory utilization or Data Storage Point plotting technique, Line drawing algorithms, Circle generator, Polygon and surface generation (Register. 2-Buffer), Hidden surface removal, Shading, Solid modelling, Two dimensional transformation, Clipping and Windowing, 3D-graphics; 3D-transformation, Parallel projection, Perspective projection.
Concept of Multimedia : Multimedia and interactivity, Multimedia technology (Sound & audio, image & graphics and animation & special effects, storage and access speed), Application Development. Multimedia Applications using UML.

CA32108 Object Oriented Technology Using C++ (3-1-0)

Object Oriented Paradigm: Basic concepts of Object Oriented Programming (OOP), Structured vs OOP Benefits of OOP, Object Modeling-Association, Aggregation and Generalization.
Introduction to C++: Tokens, Keywords, Identifiers, Variables, Data types, Operators in C++, Expressions and Implicit Conversions, Control Structures.
Functions in C++: The Main Function, Function Prototyping, Passing arguments to a function, Inline Functions. Default Arguments, Function Overloading, Friend and Virtual Functions, Storage Classes.
Classes and Objects: Class Declaration, Defining Member Functions, Nesting of Member Functions, Private Member Functions, Arrays within a class, Creating Objects, Arrays of Objects, Objects as Function Arguments. Pointers to Members, Difference between Structures and Classes.
Constructors and Destructors: Constructors, Constructors with arguments, Multiple Constructors, Constructors with Default Arguments, Dynamic Initialization of Objects, Copy Constructor, Destructors.
Operator Overloading: Defining Operator Overloading, Overloading of Unary and Binary Operators Manipulation of Strings Using Operators, Rules for Over loading Operators, Type Conversions.
Inheritance: Introduction, Base and Derived Classes, Different forms of Inheritance, Virtual Base Classes. Abstract Classes, Constructors in Inheritance, Overriding Base Class Members.
Virtual Functions and Polymorphism: Introduction, Pointers to objects, this Pointer, Pointers to Derived Classes, Virtual Functions, Pure Virtual Functions, Friend Functions.
Files and Streams: Stream Classes, Opening and Closing of Files, File of Arrays, File of Structures. File Pointers and Their Manipulations, Error Handling During File Operations, Command-Line Arguments.
Templates and Exception Handling: Introduction, Class Templates, Function Templates, Member function Templates, Concept of Exception Handling, Different Types of Exception, Throwing Exception from a Function, Multiple Catch Statements.
GUI using VC++ : Introduction, Object-oriented programming and event-based programming using Microsoft foundation classes (MFCs), OLE (Object linking and embedding), OLE Automation, OLE Controls and Dynamic Link Libraries (DLLs).

CA32109 Numerical Computations (3-1-0)

Computer Arithmetic : Floating point representation of numbers, arithmetic operations with normalised floating point numbers and their consequences. Error in number representation, pit-falls in computing.
Iterative Methods : Bisections, false position, Newton-Raphson methods, Discussion of convergence. Polynomial evaluation, Solving polynomial equations, Barstow's Methods.
Solution of simultaneous linear equations and ordinary differential equations: Gauss elimination method. pivoting, ill conditioned equations, refinement of solution, Gauss-Seidal iterative method, acceleration of its native methods, Taylor series & Euler methods, Local & global error analysis, Runge-Kutta methods; Predictor corrector methods, Automatic error monitoring and change of step size, Stability of solution.
Interpolation and approximation : Polynomial interpolation, difference table, difference calculus, Inverse spline interpolation, linear regression, polynomial fitting and other curve fittings, approximation of functions by Taylor series and Chebyshev polynomials.
Numerical differentiation and integration : Differentiation formula based on polynomial fit, pitfalls in differentiation, Trapezoidal & Simpson rules, Gaussian Quadrature.

CA32110 Graph Theory and Network flows (3-1-0)

Introduction and Basic Concepts : Definition, Representation of graphs, Finite and infinite graphs, Directed graphs, Incidence and degree, Bipartite graph, Planar graphs, Matrix representation of graphs. Applications of graph in computer science.

paths and Circuits : Isomorphism, Subgraphs, Walks, Paths and Circuits, Connected and disconnected graphs, Euler graphs, Operations on graphs, Hamiltonian graphs, Travelling salesman problem.
Trees and Fundamental Circuits : Definition, Properties of trees, Spanning trees, Fundamental circuits and cut-sets, Connectivity and separability, Minimal spanning tree and connected algorithms, Rooted and Binary trees, Applications of trees.
Shortest Path Problems : Shortest path algorithms, Generalized shortest path algorithms, Applications of shortest path problems.
Network Flow Problems : Flows in network, formulation, Max-flow min-cut theorem, Minimum cost flow problems, Multicommodity network flow problem, Decomposition of multi-commodity network flow problems.
Tours in Networks : Euler tours, Postman and Travelling salesman tours in networks, Algorithms for tours in networks with applications, Vehicle routing and Scheduling problems.
Flow Graphs : Definition, Methods of solution, Path inversion, Application of flow graphs for system modeling. Project management by network (PERT & CPM) techniques, Graphical evaluation and review techniques (GERT).

CA32111 Operating Systems (3-1-0)

Introduction : Evolution of operating systems. Types of operating systems. Different views of the operating system, operating system concepts and structure.
Processes : The Process concept, Mutual exclusion, semaphores, Implementation of semaphores, shared data, critical sections, busy form of waiting, lock and unlock primitives, synchronization, block and wakeup.
Scheduling : Process states, virtual processors, interrupt mechanism, scheduling algorithms, implementation of concurrency primitive.
System deadlock : Prevention, detection and avoidance.
Memory Management : Address protection, segmentation, virtual memory, paging, page replacement algorithms, cache memory, hierarchy of memory types, associative memory.
Multiprogramming system : Queue management, I/O supervisors, memory management, File system, disk cheduling,
Introduction to machine and assembly language programming : Distinction between system software and application software.
Assemblers, linkers, loaders, compiler, interpreter, editors, debuggers and interactive programming environments.
Typical current operating systems such as WINDOWS (NT), LINUX (UNIX) and their use.
Advanced topics : Distributed operating system and Network operating system.

CA32112 Marketing Management (3-0-0)

Introduction, consumer behavior, marketing planning, market development & segmentation, demand forecasting, product, distribution, pricing policies & practices, promotion strategy, advertising, sales force management, sales promotion, publicity & public relations; marketing of services; industrial marketing; marketing for non-profit organization; international marketing; marketing research & marketing information system.

Third Semester

CA33113 System Analysis & Design (3-0-0)

Overview of System Analysis and Design: System definition & concepts, System models, Role and attributes of system analyst, Systems development life cycle-Project selection, Analysis, Design, Implementation, Testing and Maintenance.
System Planning: Data and fact gathering techniques, Feasibility analysis, Project selection plan and proposal, Prototyping, Cost-benefit analysis.
Information Requirement Analysis: Concept of structured analysis, Tools of structured analysis-Data flow diagrams, Data dictionaries, Structured English, Decision Trees and Decision Tables.
System Design: Process and stages of System Design, Logical and Physical Design, Process modelling with physical and logical DFD's, System flow charts and structured charts, Data modelling with ERD's.
Modular and Structured Design: Modularization, Module specification, Module coupling and cohesion, Top-down and Bottom-up design.
Input / Ouput and Form design : File and Database Design, User-interface design, Prototyping, Use of CASE tools, System documentation and their importance.
System Implementation and Maintenance: Test planning, Implementation planning and performance evaluation, Testing and validation, Performance and acceptance criteria, System quality control and assurance,

Reviews and walkthroughs, Maintenance activities and issues, Audit trails and system security.
Analysis and Design in Object-oriented Platforms: Introduction object modeling, Object oriented analysis and design through object modeling techniques, Dynamic modeling and functional modeling, Process of Object oriented design, Object oriented programming systems for implementation, Object oriented databases.

CA32114 Operations Management (3-1-0)

Planning and control, Plant location and routing, Forecasting and time series analysis, Aggregate production planning and smoothing, Project management, Scheduling and sequencing of production system, Quality assurance & control, Inventory control, Maintenance planning and management, Application of computer in the field of Production Management.

CA32115 Data Base Management Systems (3-1-0)

Basic concepts: Database & Database Users, Characteristics of the Database, Database Systems. Concepts & Architecture, Data Models, Schemas & Instances, DBMS Architecture & Data Independence, Data Base languages & Interfaces, Data Modelling using the Entity-Relationship Approach.
Relational Model, Languages & Systems: Relational Data Model & Relational Algebra, Relational Model Concepts, Relational Model Constraints, Relational Algebra, SQL-A Relational Database Language, Date Definition in SQL, View & Queries in SQL, Specifying Constraints & Indexes in SQL, Specifying Constraints & Indexes in SQL, A Relational Database Management Systems, ORACLE/INGRES
Conventional Data Models & Systems: Network Data Model & IDMS Systems, Membership types & options in a set, DML for the network model, Navigation within a network database, Hierarchical Data Model & IMS System, Hierarchical Database structure, HSAM, HISAM, HDAM & HIDAM organisation, DML for hierarchical model, Overview of IMS.
Relational Data Base Design: Function Dependencies & Normalization for Relational Databases, Functional Dependencies, Normal forms based on primary keys, (1NF, 2NF, 3NF & BCNF)Lossless join & Dependency perserving decomoposition.
Concurrency Control & Recovery Techniques: Concurrency Control Techniques, Locking Techniques, Time stamp ordering, Gravularity of Data items, Recovery Techniques, Recovery concepts, Database backup and recovery from catastrophic failures. Concepts of Object oriented data base management systems, UML for Database Design.

CA32116 Computer Communication and Network (3-1-0)

Advantages of networks, structure of the communications network, point-to-point and multidrop circuits, data flow and physical circuits, network topologies, topologies and design goals, Hierarchial topology, horizontal topology (Bus), star topology, ring topology, mesh topology. The telephone network, switched and nonswitched options, fundamentals of communications theory, channel speed and bit rate, voice communications and analog waveforms, bandwidth and the frequency spectrum, connecting the analog and digital worlds, digital worlds. digital signals, the modem, asynchronous and synchronous transmission.
Wide area and local networks, connection oriented and connectionless networks, classification of communications protocols, time division multiple access (TDMA), time division multiplexing (TDM), carrier sense (Collision) systems, token passing, peer-to-peer priority systems, priority slot, carrier sense (Collision free) systems, token passing (Priority) systems.
Layered Protocols and the OSI model: Goals of Layered Protocols, networks design problems, communication between layers, introduction to standard organizations and the OSI model, standards organizations, Layers of OSI, OSI status.
Polling / Selection Protocols: Character and bit protocols, binary synchronous control (BSC) HDLC, HDLC options, HDLC frame format, code transparency and synchronization, HDLC transmission process, HDLC subsets, SDLC, Protocol conversion.
Local Area Networks: Primary attribues of a LAN, Broadband and baseband and base LANs, IEEE ALAN standards, relationship of the 802 standards to the ISO/CCITT model, connection options with LANs, LLC and MAC protocol data units, LAN toppologies and protocols, CSMA/CD and IEEE 802.3, token ring (Priority). token bus and IEEE 802.4, metropolitan area networks (MANs), ANSI fiber distributed data interface.
Switching and Routing in Networks: Message switching, when and when not to use packet switching, packet routing, packet switching support to circuit switching networks.
The X.25 Network and Supporting Protocols: Features of X.25, Layers of X.25 and the Physical layer, X.25 and the data link layer. Companion standards of X.25, features of X.25, X.25 channel options, flow control principles, other packet types, X.25 logical channel states, packet formats, internetworking, connectionless model networks, the frame relay and X.25 stacks.

TCP / IP:TCP/IP and internetworking, example of TCP/IP operations, related protocols ports and sockets. The IP address structure, major features of IP, IP datagram. Major IP services. IP source routing, value of the transport layer, TCP, Major features of TCP, passive and active operation, the transmission control block (TCB), route discovery protocols, examples of route discovery protocols, application layer protocols,
Personal Computer Networks: Personal computer communications characteristics, error handling, using the personal computer as a server, linking the personal computer to mainframe computers, file transfer on personal computers, personal computers and local area networks, network operating systems (NOSs), common IBM PC LAN protocol stacks.

CA32117 Parallel and Distributed Processing (3-1-0)

Basic concepts: Introduction to Parallel processing, Parallel Processing terminology, Decomposition, Complexity, Throughout, Speedup, Measures, Data Dependence, Resource Dependence, Bernstein's conditions, Levels of parallelism programs. Program flow-control Flow, Data Flow.
Distributed Systems : Introduction, Advantages, Tightly-coupled, Loosely-coupled systems. Hardware and Software requirements, Design issues.
Parallel Processing-Structure & Organization: Taxonomy of parallel processes; granularity, Basic Architectures, Multiprocessors, Vector processors, Pipeline, Array, Systolic, Wavefront array, Cube Architecture, Hypercube, CCC, Pyramid, Prism. Network architecture-Binarytree, Hypertree Butterfly, Shuffile exchange. Dataflow Architecture, Connection Machine.
Distributed Systems: Review of Networks, Layered Protocols-Physical, Data Link Network, Transport, Application. Network Operating System. Distributed Operating system Resource sharing. Message Passing Example system. Synchronization aspects, Clocks, Algorithms, Mutual Exclusion, Coroutines, CSP, DP, Deadlocks, Distributed deadlock detection. Modelling-Petri Nets.
Parallel Algorithms: PRAM Model of computation, Elementary Parallel Algorithms-Broadcast, Prefix sums, Permutation, Parallel Selection, Merging, Sorting, Odd-Even, Bitonic Merge, Dictionary Operations, Elliss Algorithm, Graph Algorithms, Matrix-Transportation. Multiplication. Solving linear systems
Parallel & Distributed Programming: Parallel Programming Environments, Models, Synchronous Asynchronous Programming, Modula-2, Occam, FORTRAN, DAP FORTRAN. Actus, Data Flow Programming, VAL.

Fourth Semester

CA34118 Financial Management (3-1- 0)

Financial statements and ratio analysis : Balance sheet, profit and loss accounts, various types of ratios based on balance sheet, income statements and their usefulness.
Working capital management : Definition, need for working capital, sources and user of working capital, determination of appropriate level of working capital (Hedging principle), Inventory mode.
Cost and management accounting : Cost terminology, cost elements-labour, material, overhead, methods of distributing overhead, methods of costing-job and process costing.
Accounting for fixed assets and depreciation : Methods for calculating depreciation, accounting for depreciation, selecting methods for depreciation, intangible assets, financing engineering enterprises-shares, bonds, debentures etc.
Budget and budgetary control : Nature, scope and importance, methods of finalisation of master budget and functional budgets.
Marginal costing : Nature, scope and importance, break-even analysis, its uses and limitations, construction of break-even chart, practical applications of marginal costing.
Standard costing : Nature and scope, computation and analysis of variances with reference to material cost, labour cost and overhead cost, interpretation of variances.
Time value of money : Interest calculation, present value factor, annuities, capital recovery and sinking fund factors, perpetuities and capitalised value, gradient and geometric series of cash flow, continuous compounding, equivalance, capital recovery cost.
Project appraisal : project evaluation, social cost benifit analysis, bank guide lines, present worth method, annual equivalent amount method, alternatives having unequal live.
Uncertainty in economic studies : Risk & return concepts, expected return in a portfolio, portfolio risk, diversifiable and non-diverifiable risk, Markowitz model; the mean variance criterion ,selection of optimal portfolio
Cost of capital, financial leverage and capital structure : component of cost of capital, cost of debt, cost of equity capital (Beta and dividend valuation model approach), weighted average cost of capital, economic value addition , financial leverage, EBIT-EPS analysis, optimal capital structure.

CA34119 System Simulation & Modelling (3-1-0)

System : Definition, Types of system-continuous and discrete.
System modelling : Definition of a model, Types of model, verification and validation of modeling procedures, comparing model data with real system data, differential and partial differential equation models, combining discrete event and continuous models.
Modelling and Performance Evaluation of Computer Systems: Behavioural, Data flow and structural modelling, Overview of Hardware Modelling and Simulation using VHDL, VHDL Description for design reuse, test generation and fault simulation for behavioural model. Single service Centre models, Central server models, models of interactive systems, use of VHDL in front-end and back-end system development. Evaluation of multiprocessor systems, workload characterization & Benchmarks.
Virtual Reality Modelling: Overview of Virtual Reality Modelling Language VRML 2.0, Creating dynamic worlds, Integrating Javascripts with VRML.
Simulation process : Use of simulation; Continuous simulation procedure; Discrete system simulation-generation of random number and random varieties, monte carlo simulation, time flow mechanism, simulation of industrial system viz, queueing system, inventory system and network systems. Simulations of aircraft models; Biological and sociological systems simulation.
Output data analysis : Statistical analysis, Measure of performance and their estimation.
Simulation languages : A brief introduction to important discrete and continuous simulation languages, study and use of one language (depending on the **availability**) in detail.
Simulation software packages such as GPSS, SIMSCRIPT, VHDL, CSMP, VRML viewers, MATLAB environment and simulation on MATLAB.

CA34120 Internet and Web Technology (3-1-0)

The Internet : Basics of Internet, Addresses and names for the Internet, Web Objects, and Sites, E-mail, World Wide Web, File Transfer, Telnet and Use net, Gophar, Wais, Archie and Veronica, Internet Chat.
Web Servers Browser, and Security : Web and Proxy Servers. The fast ready connections on the Web, Web browsers. Netscape Communication Suite, Microsoft Internet explorer, the Virus menace in the Internet, Firewalls. Data Security.
Creating a Website and the Markup languages : The Art of creating a Website, Hypertext and HTML, HTML document features, Document Structuring Tags in HTML, Special Tags in HTML, Dynamic HTML, XML and Microsoft front page.
Searching and Web – Casting Technologies : Introduction, Search Engine, Search Tools, Getting found or hidden data, Channels and Channels Push Technology.
Network and Security programming : Network Programming, URL classes, Socket classes, Programming for security.
The Dynamic Functionality in Web Pages : CGI, CGI Script Communication, CGI script languages, A Scripting Language, Java Script, Dynamic Page Functionality Using servlets and JSPs, ASPs, COMs, DCOMSs
Web Servers : Introduction to Web servers, Web servers programming.

Building Web Applications with UML.

CA34121 Software Engg. – I (3-1- 0)

Software Engg.: Definition, Program Versus Software, Software process.
Software life cycle: Waterfall, prototyping, iterative, spiral, Modern & old, Model.
Software Requirement specification (SRS) and Analysis: Problem Analysis (DFD, Data Dictionary, E-R Diagram EER diagram), Approaches of problem Analysis, Nature of the SRS, Character of a good SRS, organisation of the SRS.
Software design: What is design, Modularity, Strategy of Design, Function oriented design, object oriented design.
Software Inspection: Review / inspection procedure, Functional spaes Review, System spaes Review, Development Review, Pre-Inplementation, Review Checklist, Post Inplemtalion Review checklist.
Software configuration management : Configuration Management Activities, Software version, Change control process.
Estimation for Software project : Cost estimation, Steps of cost estimation, Alternative Estimation methods, Project classification, program level Estimation, Approximate Breaking of Efforts Estimate, Factors delaying projects, How do programmers spend their time.
Documentation : User documentation, System documentation etc.

CA34122 Decision Support Systems (3-0-0)

Decision Making Perspective: Managerial Decision Making and management Information Syst
Framework for Decision Support Systems; MIS-DSS-ES connection.
DSS: The Basic Concepts: Components of DSS; data management, model management sub syster
user interface sub system; DSS hardware and software; classification of DSS and their support.
Modelling and Model Management: Static and Dynamic Model; Optimization via mathematical program
linear programming models; integer programming models; dynamic programming models; simulation; dis
event simulation; generation of random numbers; simulation process languages; heuristic program
forecasting.
Decision support system construction: The system development life cycle; DSS development pr
and strategies; approaches to DSS construction; end user computing and user developed DSS
generators; selection of a DSS generator and other software tools.
Implementation and Evaluation of DSS: Models of implementation; Implementation strategies; Eval
Group DSS: Fundamental of GDSS; the technology of GDSS; constructing of GDSS; commercial
software.
DSS: Through internet/intranet.

Fifth Semester

CA35113 Organisational Behaviour and Human Resource Management (3-0-0)

Introduction to organisational behaviour; organisation; individual behavriour; group and inter-group beh
motivation and work performance; leadership; organisational climate; communication, Format of orga
structure.
Introduction to human resource management; planning & procurement of human resources; train
development; promotion, transfer demotion and discharge; performance appraisal and compe
participative management.
Types of Business organisation, Labour laws; industrial conflict; conflict resolution & collective ba
Formation of Company.
Human resource information systems.

CA35124 Software Engg. – II (3-1-0)

Need of software project management: Why project management, meaning of project manageme
of project management, levels of management, software costs, classification of software projects,
project management and other project, plurality of goals & means.
Structured projects: Old projects, structured project, structured Techniques, structured analysis, Data
diagram, structured design, structured programming.
Software quality assurance: Need, software quality and its contributing factors, user view of quality,
ensuring quality (planing, methodologies, awareness / knowledge, user interface, communication, n
poor documentation), objectives.
Software reliability & Testing: Importance, reliability concepts, reliability model.
Testing: Testing process, Functional Testing, Structured testing, Test activities, Debugging, Testing
Software maintenance: Concept of maintenance, maintenance process, maintenance model
engineering.
ISO 9000 : Mapping ISO 9000 to the CMM, Contrasting ISO 9001 and the CMM
UML in Software Engineering & Software Quality.
Case tools.

CA35125 Network Programming (3-1-0)

Communication Protocol, Internet protocols Novell network system, System network architecture, U
SPX for LANs. Protocol comparisons.
Berkeley sockets: Overview. Unix domain protocols, Socket addresses. Socket system calls, Reser
Passing file descriptors, I/O asynchronous and Multiplexing, socket implementation.
Winsock programming: Using the windows socket. API Window sockets and blocking I/O. Othe
extensions. Network dependent UNRI ( ) DLL. Sending and receiving data over connections. Term
Novel IPX/SPX: Novel's windows drivers. Netware C interface for windows. IPX/SPX procedure.
communication. Connection oriented communication with SPX. IPX/SPX implementation of DLL.
Programming applications: Time and date routines. Ping. Trivial file transfer protocol Remote logir

CA35126 Artificial Intelligence and Applications (3-1-0)

Scope of AI: Games, theorem Proving, Natural language Processing: Vision & speech processing, Robotics, Expert Systems; AI techniques-Search, Knowledge, Abstraction.
Problem Solving: State space search, Control Strategies (Depth first search, Breadth first search, Production systems). Problem Characteristics (Decomposable, ignorable, recoverable, predictable).
Use of Heuristics: Hill climbing; Best first search; A* algorithm : Admissibility; AND/OR graph – AO*; Constraint satisfaction (Cryptoarithmetic, Waltz Line Labelling).
Game Playing: Minimax search; Alpha-Beta pruning.
Knowledge Representation: Predicate Logic (Well formed formulas, quantifiers, Prenex Normal Form, Skolemization, Unification, modus pones, Resolution refuation-various strategies).
Rule Based Systems: Forward reasoning: Conflict resolution; Backward reasoning: Use of No backtrack.
Structured Knowledge Representations: Semantic Net ; slots, inheritance; Frames-exceptions and defaults-attached predicates; Conceptual Dependency formalism. Object Oriented Representations.
Natural Language Processing: Syntactic analysis, Top down and bottom up parsing, Augmented Transition Networks, Semantic analysis, case grammars,
Handling uncertainty: Probabilistic reasoning (Bayes Net, Dempster Shafer Theory). Use of Certainty Factors, Fuzzy Logic Nonmonotonic reasoning (Dependency directed backtracking, Truth maintenance systems).
Learning: Concept of learning, Learning automation; The Genetic algorithm; Learning by induction; Neural Networks (Hopfield Networks; Perceptrons – Learning algorithm, Backpropagation Network, Boltzman Machine, Recurrent Networks).
Planning: Components of Planning System; Plan Generation Algorithsm (Forward State Propagation, Backward State Propagation, Nonlinear Planning using constraint posting).
Expert Systems: Need & justification for expert systems-cognitive problems, Expert System Architectures (Rule Based systems, Non Production System), Knowledge acquisition. Case studies MYCIN, R1.
AI Programming Languages:
PROLOG: Syntax; Procedural and Declarative meanings; Prolog unification mechanism; Anonymous variable, Lists; Use of fail, CUT, not.
LISP: Basic; Concepts; Eval Function; Functions and Variables; Scoping of LISP variables; Iteration and recursion.
UML in Artificial Intelligence.

CA35127 Data Warehousing & Data Mining (3-1-0)

Data Warehousing : Basic concepts and need for data warehousing. The building blocks. Data design, data preparation and dimensional modeling. Data warehouse architecture and meta data. Multi-dimensional databases-OLAP, ROLAP, MOLAP. Data warehouse implementation, information delivery systems including web-based technology and developing end user application.
Data Mining : Basic concepts and knowledge discovery. OLAP Vs data mining. Data mining techniques-association, classification, clustering, decision trees, neural network, genetic algorithm.
Use of OR & statistical techniques. Business applications and case studies.

LIST OF ELECTIVES

1. Design & Analysis of Algorithm
Review of basic data structures such as stacks, queues, linked lists, trees and graphs.
Concepts in algorithm analysis, asymptotic complexity, Domain independent algorithm design techniques such as divide and consquer greedy method. Dynamic programming, backtracking, branch and bound techniques. Example algorithms for above techniques from sets, graphs, text processing internal and external sorting, height balanced trees, B-trees, hashing algorithms, dynamic storage allocation, garbage collection.
Lower bound theory and theory and NP-hard problems.

2. Compiler Design
Introduction to Compiling and one pass compiler, Finite Automata & Lexical Analysis, Syntax Analysis & Parsing Techniques, Automatic Construction of Efficient Parsers, Syntax Directed Translation, Run Time Environment Intermediate Code generation, Error Detection and Recovery, Code Optimization
Code Generation, Compiler Design & Implementation Using UML

3. Image Processing
Image digital representation, Elements of visual perception. Sampling and quantisation. Image processing system elements.
Fourier transforms. Extension to S-D, DCT, Walsh, Hadamard transforms.
Enhancement and segmentation: Histogram modification, Smoothing, sharpening, Thresholding, Edge detection,

Segmentation, Point and region dependent techniques.
Image encoding: Fidelity criteria, Transform compression, KL, Fourier, DCT, Spatial compression, Run length coding, Huffman and contour coding.
Restoration : Models, Invrse filtering, Least squares filtering, Recursive filtering.

4. UNIX & Shell Programming

Overview of UNIX Architecture: Kernel: Processes; Time sharing, Shell, Files and directories, Creation of a file, Inode numbers and filenames, File security, file systems, Peripheral devices as files.
UNIX Editors and Basic UNIX commands: ed editor, vi editor, Redirections, piping, tees, filters, UNIX utilities, grep, sed, awk, tr etc.
Introduction to Shell Scripts: Bourne shell, C Shell, Shell variables, scripts, metacharacters and environment, 'if' and 'case' statements, For, while and until loops.
Awk Programming: Awk: pattern scanning and processing language, BEGIN and END patterns, Awk arithmetics and variables, Awk Built-in variable names and operators.
Introduction to UNIX Internals: Process management, Memory management, File and directory structure, Security.
Introduction to Systems Administration: The System Administration: the need and the role, Function of a System Administrator.
System Calls and C Function Library: UNIX system calls, C library function and math library, Standard I/O package, File handling, Command line parameters, UNIX-C interface, C files, Graphics.
Local Networking: General concepts - NIFS, NIS - their functionalities, Berkeley and Arpa services - their functionalities and services, X terminals - windows Manager, XDM, Safety aspects in local networking.
Global Networking: Electronic Mail - domain concept mail feed configuration, uucp - configuration versions protocols - uucp front ends, uucp and electronic mail, News services.

5. Client / Server Technology

Introduction to Client/Server Computing. Client/Server Management issues. Building and Managing Client/Server Systems. Network Operating Systems (Nos). Client/Server Architecture. What is Middleware? Implementing a Client/Server System. Client/Server Databases. Distributed Databases. Internet, Intranet, and Extranet. Organizational Support and Management. Client/Server Security.

6. Microprocessors & their Interfacing

Microprocessor Architecture, Instruction Set, Assembly Language Programming, Interrupts and Timing Diagrams Data Transfer Schemes.
General and Special Purpose I/O Interface Chips, Memory and I/O Interfacing.
Typical Applications in Electric Drives, Instrumentation, Control and Power Systems.
Introduction to PLC.

7. Computer Aided Design

Fundamental of CAD :Design Process, Application of Computers for Design, Creating the Manufacturing Data Base, Benefits of CAD.
Hardware in CAD: Introduction, Design work station, Graphics Terminal, Operator input devices, plotters and other output devices, CPU, Secondary storage.
Computer Graphics Software and Data Base: Software configuration of graphics system, Functions of a Graphics Package, Constructing the Geometry, Transformations, Wire frame and Solid Modeling, CAD/CAM integration
CAD/CAM Implementation: Turnkey CAD/CAM Systems, Selection criteria, Evaluation of alternative systems. Future of CAD/CAM.

8. Enterprise Resource Planning

Enterprise Resource Planning: Basic issues, approach and data base implementation. ERP, module. Production planning, Sales and distribution, Materials Management, Plant maintenance, Quality Management, Project Management, Financial and Costing and Human Resources. ERP Implementation: Strategy and Steps. Case studies in ERP Implementation.

Neural Networks and Soft Computing

Overview of Crip Sets and Fuzzy Sets, Fuzzy Relations and Fuzzy Logic, Introduction to Neural Networks, Multilayered Networks, Recurrent Networks and Unsupervised Learning, Associative Memories, Fuzzy Systems and Neuro Fuzzy Systems, Applications of Fuzzy Sets and Neural Networks in the following Areas: Applications in Patterns Recognition, Image processing and Computer vision; Applications in Controls; Fuzzy controllers, Neuro controllers and Fuzzy Neuro Controllers; Applications in Expert Systems and Decision Making Systems. Applications in Real World Computing. Use of MATLAB.

Supply Chain Management

Supply Chain and its components, Fluid flow approximation to supply chain, Customer focus, Customer Accounts Profitability and Distribution Segmentation, Direct Product Profitability and Distribution Strategy, Global sourcing. Just in Time Purchasing, Strategic Productive Purchasing, Consolidation Warehousing, Strategic alliance and

Partnership in Supplies and Distribution. Vendor, Distributor and Retailer Evaluation Methods, Logistics Management : Warehouse location. Lot size and Buffer stocking policies, Vehicle routing, Cross-ducking and Quick response logistic, EDI in Supply Chain, Supply Chain Management as a strategy for global competitiveness.

E- Commerce & E- Business

E-Business: E-business fundamentals, application development technology, internet business skills, gaining market intelligence using www, internet security for business application.
Electronic Commerce: Introduction, Impact of EC, Strategies for adopting EC, Tools and technologies for EDI and EC, Work flow systems, Bar coding, Article numbering etc., EC over internet, EC resources, Fundamental processes, Price making methods, Applications.
Architectured Framework of EC, Consumer to Business electronic commerce, consumer oriented application, models from the consumers and merchant's perspective, STOREFRONT TECHNOLOGY , Virtual MALL except.
Business to Business EC
Virtual private networks, extranets, EDI, Electronic Payment systems, concerns for E-commerce growth, Methods and mechanism, Security Issue in Electronic commerce, Legal Issue in Electronic Commerce, Trackmarks, cyberspace and the Internet, Digital signature law, Current Research and future direction.

Industrial Robotics and Automation

Industrial Robotics:

a) Robot Technology

Robot Anatomy, control systems, accuracy and repeatability, end effectors, sensors in Robotics.

b) Robot Programming:

Types of programming, Leadthrough programming, Robot languages, off-line programming, workcell control.

c) Robot Applications:

Characteristics of Robot applications, Robot cell Design, types at robot applications, Material handling application, processing operation Assembly and Inspection.

Automation:

a) Introduction, Hard automaton, Flexible automaton, Quality and automation.
b) Sensors: Manual Switches, limit switches, proximity switches, photoelectric Sensors, Infra-red Sensors.
c) Analyzers: Counters, Timers, Bar Code readers, Optical encoders.
d) Actuators: Cylinders, Solenoids, Relays,
e) Drives: Motors, kinematic linkages, Genevas, Walking Beams.
f) Machine Vision Systems: Image Scanning, lighting; digitization, windowing, thresholding, shape identification, Template matching, Edge detection, Roberts cross-operators.

Advanced Optimization Techniques

Queucing models, non-linear programming including geometric and quardratric programming, dynamic programming (stochastic models), reliability and replacement problem.

Pattern Recognition

What is Pattern Recognition? Applications ad Relation with other fields like Data Mining, Information Retrieval, etc. Linear Discriminant Functions and its Applications. Bayesian Decision Theory, Maximum-Likehood and Bayesian Parameter Estimation, Component Analysis, E-M technique, Hidden Markov Model, Non-Parametric Techniques: Nearest Neighbour, K-NN. Non-metric Methods: Decision Trees, ID3, Grammer based Methods. Neural Network Based Approaches, Fuzzy Logic Based Techniques, Support Vector Machine, Applications.

Advanced Computer Architecture

Introduction of parallel Processing : Parallel processing mechanisms; Parallelism in uniprocessor systems. Parallel Computer Structures : Architecture classification scheme.
Pipeling and Vector Processing : Instruction and arithmetic pipelies; Vector processing requirements; Pipeline computers and vectorization methods; Various vector processor-STAR 100, CRAY-1, CYBER-205, Fujitsu 200 and their special features.
SIMD Array Processors : Parallel algorithms for array processors; SIMD computers and performance enchancement.

Multiprocessor Architecture and Programming : Functional Structures, Interconnection networks, parallel memory organization; Multiprocessor Control and Algorithms, Interprocess Communication Mechanism. System Deadlocks and Protection, Multiprocessor Scheduling Strategies, Parallel algorithms for multiprocessor-synchronous and asynchronous.
Data flow Computers : Data-driven computing and languages; Advantage and potential difficulties, etc.

Network Security

Practical topics in network security and cryptography, cryptographic protocols, inter-networking security mechanisms, private and public key encryption, IPSEC-Internet Protocol security architecture.

Digital Signal Processing

Classification of signals & systems, Fourier analysis of periodic and aperiodic, continuous – time signals & system, Application of Laplace trans form to system analysis, Z transform, Linear time invariant system, Discrete and fast Fourics transform, FIR & IIR filters, Realisation of digital linear system, Effect of finite word length in digital filters, Multirate digital signal processing, Spectral estimation, Adaptive filters, Application of digital signal processing, MATLAB programs.

Managerial Economics

The theory of Consumer behaviour : The concept of utility, indifference curve analysis, demand analysis, the concept of elasticity.
Supply analysis: The law of supply, derivation of supply curve, the concept of reservation price.
The theory of production : The production function (cobb-Douglas) law of production (laws of returns of scale. the law of variable proportions, equilibrium of the firm, choice of optimal combination of factors, choice of optimal expansion path).
The theory of costs: Analysis of the concepts of costs, the traditional theory of cost (short-run costs, long-run cost- the envelope curve), modern theory of costs (short-run and long run costs, the L shaped scale curve) the analysis of economies of scale (real economies of scale, pecuniary economies of scale).
Theory of the firm and market analysis: Perfect competition (Assumptions, short-run and long-run equilibrium, dynamics changes and industry equilibrium), monopoly (definition, demand and revenue, costs, equilibrium of the monopolist, predictions in dynamic changes, the multiplant firm), price discrimination (assumptions types of price discrimination, price discrimination and elasticity of demand),monopolistic competition (assumptions, product differentiation and the demand curve, equilibrium of the firm), classical oligopoly (assumptions, the 'kinked demand model' price leadership (collusive oligopoly).
Theory of pricing : Full-cost pricing principle, average cost pricing principle.
Theory of Distribution: The marginal productivity theory, Rent-modern theory of rent, wages- meaning, determination of wages in competitive market, Monopsony in labour market, unions and wages, interest-time preference, the classical theory, the loanable funds theory, keynes liquidity preference theory, profits-meaning, different theories of profit.

Embedded Systems

Introduction to embedded systems, architecture of embedded systems, specifications of embedded systems, design methodologies, real time issues: modeling, specification, communication, scheduling, protocols etc., hardware software partitioning, approaches to software and code generation, operating system issues, memory and low power issues, validation approaches, distributed embedded systems.

Wireless Communications and Mobile Computing

The cellular concept and frequency planning, Mobile Radio, Propagation/Fading Channel, Basics of Multiple Access Schemes (FDMA/TDMA/CDMA/SDMA), Error Control Codes specifically for wireless Communications (GSM and WCDMA), Introduction to some wireless communications standards (GSM, WCDMA, BLUETOOTH, WAP).
Overview of mobile computing, wireless and mobile computation-SS7 and GSM, mobile IP, wireless mobile ATM, multicast routing protocols, location management, mobile agents, mobility management.

Formal Language and Automata Theory

Introduction to automata : Alphabet, Language, Grammar, Concepts of automata theory, Some applications.
Finite automata: An informal picture of finite automata, Deterministic and non-deterministic finite automatas, Language recognized by finite automata, Equivalence of deterministic and non-deterministic finite automata, Finite automata with epsilon-transitions.
Regular expression and languages: Regular expressions, Language associated with regular expressions, Connection between regular expression and regular languages, Finite automata and regular expressions, Regular grammars, Equivalence between regular languages and regular grammars, Chomsky classification of languages, Proving languages not to be regular, Pumping lemma and its applications, Properties of regular languages, Minimization of automata.
Context free grammars and languages: Context free grammars, Context free languages and derivation trees, Ambiguity in grammars and languages, Properties of context free languages, Normal forms of context free grammars, Pumping lemma for context free languages.
Pushdown automata : Basic definition, Language recognized by pushdown automaton, Pushdown automata and context free languages, Context free grammars for pushdown automata, Deterministic pushdown automata.
Turing machines: Definition, Turing machine model, Representation of Turing machines, Design of Turing machines, Turing thesis, Non-deterministic Turing machines, Universal Turing machine, Turing machine and Type 0 grammars, Halting problems of Turing machine, Turing computability, The Chomsky hierarchy, Primitive recursive functions, Linear bounded automata and context sensitive languages, Decidable and undecidable problems, Post correspondence problem.

Faulty Tolerant Computing

Introduction to redundancy theory, limit theorems, decision theory in redundant systems
Hardware fault tolerance : Computer redundancy techniques – detection of faults replication and compression techniques – self repairing techniques – concentrated and distributed voters. models of fault tolerant computer – case study of existing systems.
Software fault-telerance : Fault tolerance versus fault intolerance, fault tolerance objectives; errors and their management strategies, implementation of error management strategies. Software fault torance techniques – software defence, protective redundancy. Architectural support of fault-telerant software protection mechanisms, recovery mechanisms.

REGULATIONS & SYLLABUS

PG PROGRAMME

(A) MASTER OF TECHNOLOGY (4 - SEMESTER)

1) Computer Integrated Design & Manufacturing (CIDM) :
(Mechanical Engg. Dept.)

2) Power System :
(Electrical Engg. Dept.)

3) Extractive Metallurgy :
(Metallurgical Engg. & Material Sc. Dept.)

4) Foundry Technology :
(Metallurgical Engg. & Material Sc. Dept.)

5) Surface Science & Engg. :
(Chemistry Dept.)

(B) MASTER OF COMPUTER APPLICATION (MCA) (6 - SEMESTER) :
(Dept. of Computer Application)

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